QUALITY ASSURANCE PROJECT PLAN
FOR
SURFACE IMPOUNDMENT STUDY
FIELD SAMPLING AND ANALYSIS PROGRAM

Revised April 18, 2000

Prepared For:

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SAIC Project No. 01-0833-08-9947-000

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Foreword

This quality assurance project plan (QAPP) describes quality assurance (QA), quality control (QC), and technical activities to be implemented during the field sampling and analysis component of the Surface Impoundment Study (SIS). This component of the SIS involves the sampling and analysis of various industrial wastes managed in nonhazardous waste surface impoundments. Data from this sampling and analysis effort will be used to verify data obtained from a survey of such surface impoundments and in the assessment of risks posed by the impounded wastes. Facility-specific sampling and analysis plans (SAPs) will be developed for each facility to be sampled. These SAPs will contain the site- and waste-specific requirements, including information regarding the waste types to be sampled, the sampling locations, the constituents of concern, method performance criteria, and the analytical methods. This QAPP provides a guide and overall approach for sample collection, sample analyses and report preparation and will be used in the development of the facility-specific SAPs.

A data quality objectives (DQOs) development document was also prepared prior to preparation of this QAPP. It describes the development of DQOs for the sampling and analysis component of the SIS, and it is included as an attachment to this QAPP.

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A1 QA Project Plan Identification and Approval

Title: *Quality Assurance Project Plan for the Surface Impoundment Study Field Sampling and Analysis Program*

The attached QAPP for the Surface Impoundment Study Field Sampling and Analysis Program is hereby recommended for approval and commits the participants of the program to follow the elements described within.

Signature: Ollie M. Fordham Jr. Date: 4/18/00
Work Assignment Manager, USEPA, Ollie Fordham

Signature: Charles Sellers Date: 4/20/00
EPA QA Officer, USEPA, Charles Sellers

Signature: Sara Hartwell Date: 4/19/00
Project Manager, SAIC, Sara Hartwell

Signature: Date: 4/28/00
QA Manager, SAIC, Dr. Harry McCarty

Signature: Date: 5/1/00
Work Assignment Manager, SAIC, Robert Stewart

Signature: Diane Anderson Date: 4/26/00
APPL Laboratory, Diane Anderson

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A2 Table of Contents

Attachment: *Draft DQO Development Document* (December 13, 1999)

List of Tables

List of Figures

A3 Distribution

A hard copy or electronic copy (readable with the Adobe Acrobat Reader®) of this quality assurance project plan (QAPP) was distributed to the individuals listed in Table A3-1.

Table A3-1. Distribution List

Name	*Phone No.*
Ollie Fordham, USEPA EPA WAM and SIS Team Member	703-308-0493
Becky Cuthberson, USEPA SIS Team Member	703-308-8447
Barnes Johnson, USEPA EMRAD Div. Dir.	703-308-8881
Shannon Sturgeon, USEPA SIS Team Member	703-605-0509
Jan Young, USEPA SIS Team Member	703-308-1568
Charles Sellers, USEPA EPA QA Officer	703-308-0504
Robert Stewart, SAIC Contractor WAM Field Team Leader	703-318-4654
Ray Anderson, SAIC Laboratory Coordinator	703-676-7867
Harry McCarty, SAIC QA Manager	703-676-7845
Fernando Padilla, SAIC Health and Safety Officer	703-318-4573
Ed Moriarty, SAIC Field Team Leader	703-676-7872
Jennifer Cohen, SAIC Field Team Member	703-318-4626
Diane Anderson APPL	559-275-2175

A4 Project/Task Organization

The project organization is presented in Figure A4-1 and discussed in the following sections. The responsibilities of the SAIC individuals designated as Project Manager, Work Assignment Manager, and Quality Assurance Manager are discussed in Sections A4.1, A4.2, and A4.3 respectively. Sections A4.4, A4.5, and A4.6 discuss the responsibilities of the SAIC individuals designated as Health and Safety Officer, the Field Team Leaders, and the Field Samplers. The responsibilities of the remaining technical staff are described in the succeeding sections.

A4.1 Project Manager

The SAIC Project Manager will coordinate the SAIC's activity and is responsible for assuring SAIC corporate management that the work is conducted in accordance with the QA requirements. For this project, Sara Hartwell will serve as the SAIC Project Manager. Ms. Hartwell's responsibilities will be as follows:

- Evaluates Work Assignment Manager and staff credentials to ensure that they conform to the QA requirements for training and experience
- Ensures that the project is appropriately organized with effective lines of communication; ensures that project responsibilities and authorities for making critical QA decisions are clearly understood
- Distributes and enforces the QAPP among contractor and subcontractor staff
- Consults with the EPA Work Assignment Manager on proposed deviations from the QAPP; and approves deviations from the QAPP with consent from the EPA Work Assignment Manager
- Reviews QA reports from the QA Manager and reviews and evaluates responses from the Work Assignment Manager; and ensures that the actions taken are timely and appropriate
- Reports program status, problems, and corrective actions as required by the contract and the QAPP
- Reports audits conducted or directed by EPA to corporate management and the SAIC QA Manager; and prepares and routes responses to the audit reports through corporate management and the SAIC QA Manager
- Reviews work products and reports to ensure that QA goals are met; and approves technical reports
- Communicates with the EPA Project Officer on issues relating to the definition and conduct of the project work assignment; and informs the EPA Project Officer of project work assignment status.

A4.2 Work Assignment Manager

The SAIC Work Assignment Manager will have overall technical oversight of the work performed under this work assignment and will be responsible for assuring the SAIC Project Manager that the work is conducted in accordance with the QA requirements. For this work assignment, Robert Stewart will serve as the Work Assignment Manager. His responsibilities will be the following:

- Evaluates staff credentials to ensure that they conform to the project QA requirements for training and experience
- Ensures that the program is appropriately organized with effective lines of communication; and ensures that project responsibilities and authorities for making critical QA decisions are clearly understood
- Ensures that the SAIC QA Manager is involved in the project from the planning stage to the issuance of the final report, is fully informed, and is kept apprised of program schedules
- Informs all staff of program and project quality assurance requirements
- Reviews and approves Standard Operating Procedures (SOPs) and Sampling and Analysis Plans (SAPs), ensuring that program QA requirements are addressed
- Ensures that the work is adequately and appropriately inspected by the SAIC Project Manager
- Reviews and approves all analytical strategies and experimental designs
- Reviews all QA reports from the SAIC QA Manager, and reviews and evaluates responses from the SAIC Project Manager; ensures that any problems detected are immediately communicated to the appropriate staff, that actions taken are timely, appropriate, and documented in the project records
- Reports project status, problems, and corrective actions as required by the contract and the QAPP
- Ensures the effective and timely completion of all sampling and analysis tasks, and ensures that all project deadlines are met
- Reviews work products and reports to ensure that QA goals are met; ensures that critical data are adequately verified or validated and approves technical reports; and reports work assignment status to the SAIC Project Manager
- Communicates with the EPA Work Assignment Manager when technical guidance is required for the conduct of the work assignment; and documents this technical guidance with the SAIC Project Manager.

A4.3 Quality Assurance Manager

The SAIC Quality Assurance Manager is responsible for keeping the SAIC Project Manager and the SAIC Work Assignment Manager informed of the QA/QC compliance status of all project activities and of any QA/QC problems. For this work assignment, Dr. Harry McCarty will serve as the SAIC QA Manager. His responsibilities will be the following:

- Conducts final reviews and evaluations of all QAPP, SAP, and analytical data review documents
- Reports reviews of final documentation to the chief contracting officer, detailing any problems and corrective action taken
- Informs all staff of the quality assurance requirements
- Reviews analytical method requirements with the SAIC Work Assignment Manager, ensuring that program QA requirements are addressed
- Reviews all analytical and sampling strategies with the SAIC Work Assignment Manager, assuring that program QA requirements are addressed
- Conducts systems, performance, and data audits of sampling and analysis activities, assessing compliance of sample collection, analysis and handling procedures, and documentation with the QAPP and SAPs
- Reports audit results along with any problems and corrective action requests to the SAIC Work Assignment Manager and SAIC Project Manager
- Reviews and documents all corrective actions with the SAIC Project Manager and the SAIC Work Assignment Manager
- Reviews any proposed deviations from the QAPP with the SAIC Project Manager; and reports QA/QC program status to the SAIC Project Manager and the SAIC Work Assignment Manager.

A4.4 Health and Safety Officer

The SAIC Health and Safety Officer will be responsible for overseeing that all SAIC personnel engaged in sample collection are properly trained for field work in accordance with all EPA specified and/or OSHA applicable health and safety requirements. For this project, Fernando Padilla will serve as the SAIC Health and Safety Officer. His responsibilities will be the following:

- Ensures that all sampling personnel have the appropriate level of health and safety training (29 CFR 1910.120) for the level of contamination in the area where they are working

- Ensures that all health and safety training has been updated at the appropriate intervals

- Ensures that all sampling personnel have the health and safety equipment required for the specific site

- Investigates any site-related emergencies, including accidents, illness or personal exposure to hazardous substances.

A4.5 Field Team Leaders

The SAIC Field Team Leaders will have day-to-day responsibility for supervision of all onsite activities and will be responsible for compliance with the QA and safety requirements. For this work assignment, Robert Stewart and Ed Moriarty will serve as the Field Team Leaders. Their duties will include the following:

- Ensure that the SAIC QA Manager is involved in the task from the planning stage to the issuance of the final report, is fully informed, and is kept apprised of program schedules

- Oversee sampling activities and ensure conformance with the sampling and analysis plan (SAP)

- Distribute and enforce the SAPs and QAPP

- Delegate Team Leader responsibility to other qualified SAIC personnel, when necessary, to maintain project schedule

- Propose and justify required deviations from the QAPP and SAP and obtain approval for deviations from the QAPP and SAP from the SAIC Project Manager

- Anticipate problems in the performance of the assigned task, and select prevention, detection, and remedial action in conjunction with the SAIC QA Manager

- Review all QA reports from the SAIC QA Manager and develop remedial action for any identified or anticipated problems; and document these remedial action systems and ensure that the problems detected are immediately communicated to the appropriate staff, that actions taken are timely, appropriate, and documented in the program records

- Routinely inspect the work during performance and document the results in the project records.

A4.6 Field Team Members (Sampling Personnel)

All SAIC field team members have had a 40-hour training course on hazardous waste sampling conducted in accordance with 29 CFR 1910.120 and have participated in annual 8-

hour refresher courses. Field Team Members report on project matters directly to the SAIC Field Team Leader. Their responsibilities include the following:

- Assist the SAIC Field Team Leader in site location and access, equipment and sample container preparation, and documentation of field activities
- Follow the QAPP and the facility-specific SAPs
- Obtain approval for QAPP or SAP deviations from the SAIC Project Manager through the SAIC Field Team Leader
- Immediately report QA problems to the SAIC Field Team Leader and the SAIC QA Manager, and help resolve the problems.

A4.7 Laboratory Coordinator

The SAIC Laboratory Coordinator is responsible for providing the analytical laboratory with the QAPP and SAPs and ensuring that the laboratory follows the protocols prescribed in those documents. The SAIC Laboratory Coordinator for this work assignment, Ray Anderson, reports to the SAIC Work Assignment Manager and his responsibilities will include the following:

- Provides the laboratory with all of the information necessary to conduct the analyses using the proper and appropriate analytical techniques; this information may include QAPPs, SAPs, draft methodologies, and oral revisions to documentation
- Ensures that the laboratory understands and has the capability and capacity to conduct the required analyses
- Ensures that the required level of QC is adhered to for all sample analyses and that project objectives are met, including that all analytes are reported at sufficient sensitivity to meet project objectives.
- Conducts reviews and data validation of all laboratory analytical reports
- Addresses laboratory QA/QC issues and recommends corrective actions
- Reports all QC discrepancies and qualifications to the SAIC WAM
- Verifies receipt and condition of field samples submitted to the laboratory
- Assures that the laboratory deliverables schedule meets project requirements
- Provides SAIC WAM with a final analytical data report.

A4.8 Technical Staff

The SAIC technical staff have the responsibility of performing specialized tasks under the guidance of the SAIC Work Assignment Manager. The SAIC technical staff for this Work Assignment are listed in Figure A4-1. The members of the technical staff will be responsible for the following:

- Perform specialized tasks as requested by the SAIC Work Assignment Manager
- Provide the SAIC Work Assignment Manager with the findings of requested tasks along with a weekly status report
- Report any problems identified to the SAIC Quality Assurance Manager, and the SAIC Work Assignment Manager.

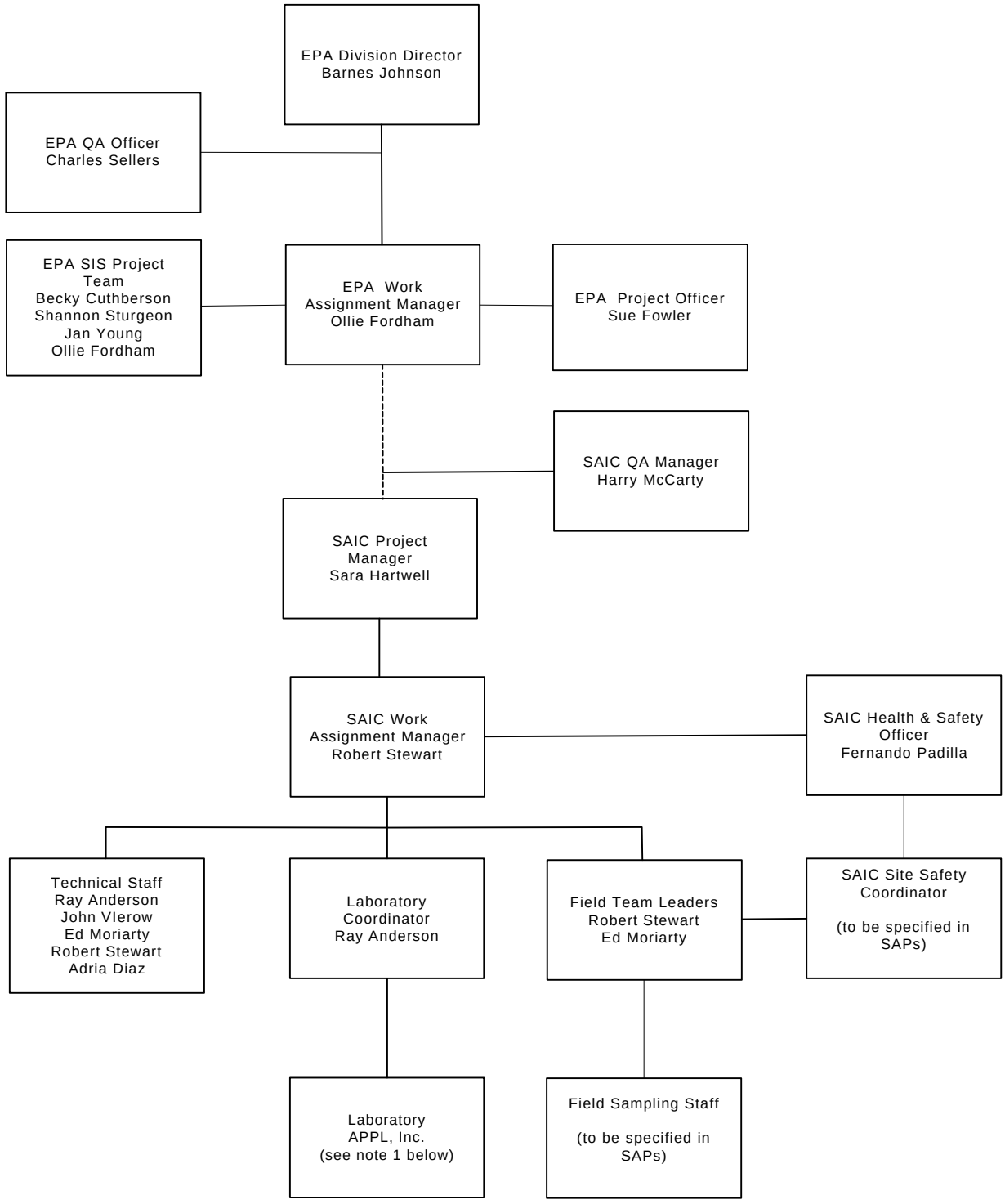
A4.9 Analytical Laboratory

The analytical laboratory, APPL, Inc., will be charged with the analysis and data reporting of all or most samples collected for the purposes specified in this QAPP. The laboratory will work directly with the SAIC Laboratory Coordinator and will have the following responsibilities:

- Provides comments on the analytical requirements
- Adheres to all requirements and protocols specified in the QAPP and facility-specific SAPs; immediately notifies requires the SAIC Laboratory Coordinator of any modifications or deviations for approval
- Informs the SAIC Laboratory Coordinator of any sample delivery, storage, QC or analytical problems
- Analyzes all samples according to the methodology specified in the QAPP and facility specific SAPs, or makes changes or alterations under the PBMS paradigm to achieve quantitation of the analytes of interest in the matrix of interest at the concentration level of interest.
- Provides monthly status reports to the SAIC Laboratory Coordinator outlining procedures performed during the period and noting any difficulties encountered; and discusses any corrective actions that were instituted
- Provides detailed Analytical Data Reports to the SAIC Laboratory Coordinator, commensurate with the protocols specified in the QAPP and facility-specific SAPs.

In addition to APPL, another laboratory may be used, dependent on the required facility-specific analyses (e.g., to conduct the dioxin/furan analyses). If this occurs, the laboratory will be identified in the facility-specific SAP.

Figure A4-1 Project Organization Chart



[1] In addition to APPL, the services of one or more additional laboratories may be required to satisfy analytical requirements. If so, the laboratory or laboratories will be identified in the facility-specific SAP.

A5 Background and Problem Statement

This section provides background information regarding the purpose of field sampling and analysis under the SIS. It also summarizes the study questions to be answered by the sampling and analysis component of the SIS, as addressed by this QAPP.

A5.1 Background

The Agency has two reasons to conduct a study of surface impoundments which includes waste sampling and analysis. First, the Land Disposal Program Flexibility Act (LDPFA) of 1996 (PL 104-119) amended Section 3004(g) of the Resource Conservation and Recovery Act (RCRA). This amendment requires a risk characterization study of waste managed in units regulated under the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) program, pretreatment program, or units in a zero discharge system. These wastes are "decharacterized" waste, meaning they formerly exhibited a hazardous characteristic such as corrosivity, reactivity, ignitability, or toxicity.

In addition, under a consent decree in the matter of *Environmental Defense Fund v. Browner*, EPA is studying waste in surface impoundments which have never exhibited a hazardous waste characteristic. This study is limited to human health risks posed by air emissions via the "direct inhalation" pathway, and thus only volatile, semivolatile, and fugitive emission constituents are of concern. One hundred and five of the chemical constituents are explicitly required to be studied. The purpose is to obtain such information as the Administrator may require to determine whether a rulemaking to promulgate a hazardous waste characteristic that addresses potential risk to human health through the direct inhalation pathway should be initiated.

In response to the 1996 LDPFA, EPA's Office of Solid Waste (OSW) began a study of facilities that manage industrial waste in surface impoundments. This study, called the Surface Impoundment Study (SIS), seeks to characterize the risks posed by managing wastewaters in surface impoundments and to determine whether existing regulations adequately address those risks. As part of this effort, OSW administered a screening survey to identify facilities having surface impoundments operating during the period of interest and to identify the type of wastewater being managed in the surface impoundments. Approximately 215 facilities were selected to receive a long survey to describe their surface impoundments.

In their review of OSW's Surface Impoundment Study Plan, the Science Advisory Board (SAB) advised OSW to apply the risk characterization scheme to a few impoundments early in the study with actual site monitoring data to provide "ground-truth." In addition, the SAB emphasized the need for obtaining extensive field monitoring data to perform model validation (i.e., "ground-truthing") by comparing calculated (modeled) values to measured values. In response to SAB's recommendation for ground-truthing and other project needs, OSW initiated the SIS Field Sampling and Analysis Program. This QAPP addresses this component of the SIS.

A5.2 Problem Statement

In order to complete the risk analyses needed to comply with the Congressional mandate, EPA needs data on chemical input, output, and loss to the environment (via the subsurface and air). These data can include actual site monitoring data, modeled data and extrapolations, data obtained from existing data bases, and assumptions. In order to address the need for actual monitoring data, OSW is requesting monitoring data from approximately 215 facilities via the *Survey of Surface Impoundments* (USEPA 1999). The data collected from these 215 facilities will be screened and modeled to determine if they pose a hazard to human health and the environment. In order to supplement the facility-supplied data, fill possible data gaps, and to provide some confidence that facility-supplied sample analysis results are reasonable, OSW will conduct field sampling and analysis of selected facilities from the set of 215.

The risk estimates derived by EPA will be one factor in EPA's determination of the need for regulations to address potential risks. In addition to the risk estimates, EPA will use the information to profile the attributes of nonhazardous waste surface impoundments and their physical settings (e.g., their hydrogeologic settings, geographic distribution, and industry patterns in the use of surface impoundments).

The primary decision statement associated with the overall SIS is as follows:

> Determine whether releases from surface impoundments that are within the study's scope pose unacceptable human and ecological risks.

For the field sampling and analysis component of the SIS, addressed by this QAPP, the additional decision statements are as follows:

> Determine, using EPA field monitoring data as a "spot-check" and using process knowledge, whether or not facility-supplied data are reasonable and within the range of values expected or whether the data should be questioned and the discrepancy investigated.
>
> Determine whether or not there are gaps in the industry supplied data and whether those gaps should be filled by conducting field sampling and analysis, or by other means (such as requesting additional information/clarification from the facility).
>
> Determine, using actual field monitoring data (both submitted by facilities and generated by EPA), whether or not the multimedia models provide accurate output.

The *Draft DQO Development Document* (Attachment A) provides further information regarding these statements.

To summarize, the purpose of the sampling and analysis effort covered by this QAPP (and the site-specific SAPs) is to provide the EPA-generated monitoring data of surface impoundments. These data will be used to verify and evaluate the monitoring data provided by the facilities in response to the survey and will create a baseline for validating the modeling activities. Ultimately, the sample analysis data generated from the field sampling program will be used in

combination with other data (e.g., publicly available data, extrapolated data, assumptions, survey data, etc.) to determine, with an acceptable degree of certainty, what risks to human health and the environment are posed by constituents present in industrial wastewaters managed in nonhazardous waste surface impoundments.

A6 Project Description and Schedule

This section summarizes the work to be performed under this QAPP and provides a schedule for task activities.

A6.1 Description of Work to Be Performed

The efforts covered by this QAPP will be performed in the following three stages:

1. Planning, including facility selection and sampling and analysis plan (SAP) development,

2. Implementation, including field sampling and laboratory analysis, and

3. Assessment, including data verification, validation, and reporting.

Each stage is summarized below.

A6.1.1 Planning – Facility Selection and SAP Development

Facilities will be selected for field sampling and analysis based on the information in the surface impoundment survey responses. Given the size and variety of the subject population of surface impoundments, the SAB recommended that the "more risky" sites be characterized more fully than those that appear to present very little risk. To accomplish this, the SAB recommended that the Agency develop and use an index of risk for screening purposes, in order that resources could be prioritized and allocated to study impoundments that might present the highest risk.

Screening criteria developed by EPA OSW, as described in OSW's *Surface Impoundment Study Technical Plan For Human Health and Ecological Risk Assessment* (USEPA 2000), will be used to rank the facilities for selection. These criteria will be used to identify the "more risky" sites. In addition to the screening criteria, other factors will be considered during site selection. These factors will include such considerations as the completeness of data in the surveys, knowledge of the industrial processes and associated waste constituent risks, and the diversity of industry types represented by site candidates.

EPA estimates that field sampling will be conducted at 15 to 20 facilities. This number is based on available time and budget and the need to further characterize "risky" sites within the various industry sectors for which there may be data gaps. SAPs will be developed for each facility selected for sampling and analysis. These plans will identify the types of wastes to be sampled (e.g., influent waste, surface impoundment liquid, surface impoundment sludge, and/or effluent waste), the waste sampling locations, the constituents of concern, the specific sampling procedures to be followed, the analytical performance criteria, and analytical methods to be used in the waste characterization.

A6.1.2 Implementation – Field Sampling and Laboratory Analysis

Each surface impoundment will be sampled and analyzed in accordance with the facility-specific SAPs, including the use of the QC procedures specified in the SAP. The laboratory will provide the raw data for verification and validation. Reports will be generated as described in Sections A9, D2, and D3 of this QAPP.

A6.1.3 Assessment – Data Verification, Validation, and Reporting

The data will be verified and validated and identified as acceptable, not acceptable, or otherwise qualified based on the project objectives. A waste characterization report will be prepared for each site and this report will provide the raw data and the results of the data validation. These reports also will contain information regarding any corrective actions or protocol changes conducted during sampling and analysis.

A final report will be prepared to summarize the data from all the facilities and reconcile the results with the original project objectives (see also Section D3 of this QAPP). The data will be compared statistically or graphically to the data in the survey. This comparison will be used to verify that the data reported by the facilities is reasonable.

A6.2 Schedule of Activities

Table A6-1 provides a timetable for the planning, implementation, and data assessment phases of the field sampling and analysis program. Ideally, selection of specific sites to be sampled will take place after EPA receives the survey responses and evaluates the need for sampling data from various industry sectors. In practice, some facilities may be granted an extension on submittal of the survey responses to allow sufficient time to complete their own sampling and analysis program. To meet the overall project schedule, EPA plans to schedule initial sampling events before all surveys are received and evaluated. This will be based on process knowledge, existing data, and general familiarity with some of the larger industry segments. After receipt of new survey data and after the initial sampling has been completed, EPA will make further decisions about the need for new sampling data and select additional sites for sampling.

Table A6-1. Schedule

Task	Target Date
Planning Phase	
Develop Data Quality Objectives	November - December, 1999
Develop QAPP	January - March, 2000
Select facilities for sampling (after surveys returned)	Start late March, 2000
Prepare facility-specific sampling & analysis plans based on survey information regarding waste types and possible constituents of concern	Start late March, 2000
Implementation Phase	
Obtain field supplies, contact facilities to be sampled, arrange staff and travel	Start April, 2000
Mobilize equipment & field team(s) and begin field sampling	Start April, 2000
Complete field sampling	June, 2000
Complete laboratory analyses of final batch of samples	July, 2000
Assessment Phase	
Complete data verification/validation	August, 2000
Deliver Final Reports (Waste Characterization Reports and Final Summary Report)	September, 2000

A7 Data Quality Objectives and Criteria for Measurement Data

This section summarizes the development of the data quality objectives (DQOs) and the measurement performance criteria for the field sampling and analysis component of the SIS. It refers to those parts of this QAPP which provide specifics regarding these important elements.

A7.1 Development of DQOs

Representatives from the OSW Surface Impoundment Study (SIS) Team were involved in the development of data quality objectives (DQOs) for the SIS Field Sampling and Analysis Program. The objective of the DQO process was to develop a sampling and analysis strategy that will satisfy the data requirements of the SIS.

To be successful, the SIS Field Sampling and Analysis Program must yield data of the type and quality necessary to achieve the purpose of the program. The DQOs will be used to define the quality control requirements for sampling, analysis, and data assessment. These objectives will be incorporated into the facility-specific SAPs and project objectives. The approach for developing DQOs for the SIS Field Sampling and Analysis Program was based on the guidance presented in EPA's *Guidance For The Data Quality Objectives Process, EPA QA/G-4* (September 1994). The *Draft DQOs Development Document* (Attachment A) provides the outputs of this process.

A7.2 Measurement Performance Criteria

The data quality for analytical measurements of the constituents will be assessed primarily by means of the following indicators: analytical sensitivity, precision, bias, completeness, representativeness, and comparability. These QC procedures and associated measurement performance criteria are described in Section B5 of this QAPP. Facility-specific objectives and performance criteria will be provided in the SAPs, as necessary, based on the waste types and analytes of concern for the particular facility.

A8 Special Training Requirements/Certification

This section summarizes the training requirements needed by the personnel conducting the field sampling for the SIS.

A8.1 Training

Personnel assigned to perform field sampling and laboratory analysis activities must meet the educational, work experience, responsibilities, fitness, and training requirements for their positions.

The subcontractor laboratory is ultimately responsible for adequately training the personnel performing supervisory, quality assurance/quality control (QA/QC), data handling, and other duties to be performed in support of the study. Management must ensure that personnel have access to the relevant guidance documents, standard operating procedures (SOPs), QAPPs, SAPs, and sampler operation manuals.

Each field team member must have completed a 40-hour OSHA site health and safety training course as mandated by 29 CFR §1910.120, participate in a medical monitoring program, and participate in annual 8-hour refresher training. All sampling personnel must have been fit-tested for respirators within the past year. Documentation of this training and monitoring of project personnel will be kept by the responsible corporate officer or his/her designee.

If required, field team members will undergo additional facility-specific training prior to sampling. Such a need will be addressed by the appropriate SAP, after consultation with facility representatives.

A8.2 Certification

Field sampling personnel must have certification of completion of their health and safety training. Certificates of completion are maintained by SAIC's Corporate H&S Officer (see Section A8.3 below).

There are no other special certification requirements applicable to the field or laboratory activities to be performed under the SIS Field Sampling and Analysis Program.

A8.3 Contact for More Information

SAIC's contact for H&S training, medical monitoring, and certification is as follows:

Fernando Padilla, CIH
E-mail: fernando.d.padilla@saic.com
Phone: 703-318-4573
Fax: 703-736-0915
Postal Address: 1251 Roger Bacon Drive
P.O. Box 4875
Reston, VA 20190

A9 Documentation and Records

This section itemizes the information and records to be included in the data reports, specifies the reporting formats, and specifies the document control procedures to be used.

A9.1 Data Recording

All hand-entered field and laboratory data will be recorded in a permanent manner. Manual original entries will be recorded in permanent ink. Instrument-generated original data will be printed as hard copy and/or will be electronically archived into a corporate archive system. Unless otherwise specified, a hard copy printout will be produced for archiving purposes.

Corrections and additions to original data will be made as follows:

- After correction, original entries must remain legible (for manual corrections) or intact for computerized corrections)
- The correction or addition must be readily traceable to the date on which it was made and to the staff who performed the correction or addition
- Corrections must be explained.

A9.2 Field Operation Records

A field logbook will be kept during field activities by the Field Team Leader on-site. This daily log will be kept in a bound field notebook of water-resistant paper. All entries will be made legibly and in indelible ink. They must be signed and dated. Information that will be recorded in the field notebook includes the following:

- Facility name and location
- Arrival and departure times
- Site representatives present
- Date, time, and place of sampling
- Field QC samples prepared, as applicable
- Sample identification numbers
- Weather conditions at time of sampling, including ambient temperature and approximate wind direction and speed
- Observations about site and samples, including verification of information supplied by the facility regarding environmental settings (e.g., flow rates)

- Information about any activities extraneous to sampling activities that may affect the integrity of the samples
- Analyses and required preservation techniques
- Sampling shipping information including air bill numbers
- Individuals conducting the sampling.

Field notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during projects, if called upon to do so, and to assist in draft and final report preparation.

Unless weather conditions restrict procedures, all original data recorded in field notebooks, sample identification tags, C-O-C records, and receipt for samples forms will be written in waterproof ink. In the case of restrictive weather, all entries to the field logbook will be made immediately following the sampling event. These accountable serialized documents are not to be thrown away, even if they are illegible or contain inaccuracies that require a replacement document. The sample identification numbers will be recorded in indelible ink on the bottle label, field logbook, C-O-C record form.

A9.3 Laboratory Records

All original data that are reported must be readily traceable to the following:

- The date the analysis was performed
- The time or order in which sampling or analysis was performed
- The staff who performed, reviewed, and validated the work
- The methods used to acquire and process data and the validation of the data
- Suppliers' lot numbers and purity information
- The equipment and equipment operating parameters and the calibration and maintenance of the equipment
- Efforts to check performance and to review improvements, alterations, or changes to meet performance requirements
- The sample codes or identification
- The work assignment number.

A9.4 Analytical Data Report Format

Subcontract laboratories will generate analytical data reports using their standard format. The elements in the report will include, at a minimum:

- Cover page, title, and table of contents
- Case narrative, containing a description of the following: sample receipt, sample preparation, analysis, quality control/assurance, calibration, laboratory manager certification
- Chain-of-custody and analysis request documentation
- QA/QC data summary tables
- Executive summary tables of analytical results
- Calibration data
- Logs of all automated and manual adjustments
- Laboratory and instrument raw data.

All reports will be paginated. The laboratory will also document any difficulties and the corrections actions taken.

A9.5 Waste Characterization Report Format

As required by the work assignment, SAIC will prepare a waste characterization report for each facility sampled under SIS sampling program. Each report will contain information about sampling and the results of analyses. Each report will include the following basic elements:

- Cover page, title, and table of contents
- Summary of field activities and observations
- Summary of analytical data
- Chain-of-custody and sample shipping records
- Photo log
- Data reduction and analysis of the raw data
- QA/QC data

- Information about corrective action and protocol changes made during sampling and analysis.

It may be necessary to classify one or more of these reports as Confidential Business Information (CBI). If that is the case, SAIC will employ procedures relative to those reports in compliance with the CBI regulations (Title 40 of the CFR, Part 2).

In addition to the facility-specific waste characterization reports, SAIC will generate a final summary report of the sampling and analysis data. The report will include a comparison of the data with the data reported by the facility in the survey.

A9.6 Records Management and Document Control

Accurate working files of all documentation, QAPPs, SAPs, logbooks, original data, QA data, calculations, deviations from approved procedures, assumptions, audits, and data review, inspection, and validation will be maintained by the laboratory or the Field Team Leader as appropriate until turned over to the corporate archives. Project records will be maintained in a systematic and logical form and adequately filed for rapid retrieval, accounted for, and appropriately indexed. The types of documentation that must be maintained include, but are not limited to the items listed below:

- Description of techniques or guidelines used to select sampling sites
- Specific sampling and subsampling procedures used, the source of the sampling protocol, and any deviations from that protocol
- Charts, flow diagrams, or tables delineating sampling program operations
- A description of the equipment, supplies, containers, procedures, reagents, etc., used for sample collection, preservation, transport, and storage
- The number, volume, and type of samples collected
- Special conditions for the preparation of sampling equipment and containers to avoid sample contamination
- Sample preservation methods and holding times. Holding times must be taken into account by the sampling team, so that the samples are shipped for timely analysis
- Equipment use logs and maintenance records, maintained by the laboratory
- Monitoring of holding times -- Target holding times will be established and frequently monitored; sample tracking systems will be used to track sample status and holding times; and project management will select cost effective tracking systems

- Forms, notebooks, and procedures to be used to record sample history, sampling conditions, and analyses performed.

B1 Sampling Process Design

This section of the QAPP describes all the relevant components of the experimental design of the SIS sampling and analysis program, defines the key parameters to be estimated, indicates how the number and types of samples will be determined, and describes when and what type of samples will be collected. It also provides the standard content and format for the facility-specific SAPs.

B1.1 Rationale for the Design

The population of interest for the Surface Impoundment Study is all wastewater managed in surface impoundments that satisfy the definition of surface impoundment specified in the *Survey of Surface Impoundments* (OMB 2050-0157), including sludges removed from the surface impoundments. By design, the population of interest for the field sampling and analysis component of the SIS will be stratified. Stratification may be based on similarities of waste management or treatment practices (e.g. biological vs. no biological treatment) or based on industrial classification, such as by SIC code or NAICS codes. Specific facilities will be selected for sampling from the various "strata" based on relative risk, heterogeneity within an industry sector, or the need to fill gaps. Selection of specific facilities for sampling will be made after review of survey results, review of the *Surface Impoundment Study Technical Plan for Human Health and Ecological Risk Assessment* (USEPA 2000), and in consultation with the EPA SIS Team.

To address the need for monitoring data, OSW is requesting monitoring data from approximately 215 facilities via the *Survey of Surface Impoundments* (USEPA 1999). To supplement the facility-supplied data, fill possible data gaps, and to provide confidence that facility-supplied sample analysis results are reasonable, field sampling and analysis will be conducted at selected facilities. The sample analysis results alone will not be used to estimate a "statistical parameter of interest" (such as the mean or a percentile), rather, the data obtained from field sampling will be used to *supplement* and "fill in" survey data as it is impractical for EPA to use field samples as a primary source of data.

The facilities in the SIS were selected from a statistical sampling frame developed for the overall study. The actual facilities at which sampling will be conducted will be selected based on the need to obtain data from that specific facility rather than by some form of random selection. Thus, selection of individual facilities for sampling by EPA will "authoritative" or "judgmental." The objectives are mainly to fill data gaps and check facility-supplied data. Authoritative sampling is a nonstatistical sampling design because it does not assign an equal probability of being sampled to all portions of the population.

B1.2 Design Assumptions

Based on the study objectives and due to practical constraints, individual facilities, media, and field sampling locations will be selected using the judgment of the EPA SIS Team and the field sampling team. To the extent possible, the sampling design will be optimized by locating facilities in geographic clusters to minimize travel time and costs.

Even though a given facility may have more than one surface impoundment, the sampling design does not necessarily include sampling of all surface impoundments at a single facility. Samples will be obtained from those impoundments selected by EPA based on their relative risk and/or the need to fill data gaps.

It is not known in advance the exact media to be sampled at each facility, and t is assumed that the media to be sampled will include influent to the surface impoundments, water within the impoundment, sludge (>5% solids) within the impoundment, effluent, and leachate from the leachate collection systems. It is also assumed that the target media will be available at the time of field sampling. The field team will make all reasonable efforts to confirm with the facility representatives in advance the availability of, and access to, the media of interest. Field conditions will be documented at the time of sample collection (see also Section A9, Documentation and Records).

B1.3 Procedures for Selecting Facilities and Locations for Sampling

EPA expects to select 15 to 20 facilities for field sampling. The selection of a facility for sampling will be dependent on the representativeness of a facility's process for the entire industry segment as well as the completeness of responses to Questions C22 through C24 in the Survey. For the industries whose wastes are heterogeneous, it will be more difficult to select one facility as "representing" the industry group as a whole, and thus the quantity of data supplied for Questions C22 through C24 would be the primary factor in EPA's selection process.

For each facility, a site-specific SAP will be prepared to indicate the media to be sampled. As stated previously, these media could include influent to the impoundment; wastewater in the impoundment; sludge in the impoundment (e.g., being removed from an active impoundment, or removed from a closed impoundment); effluent from the impoundment; and leachate from a leachate collection system. The exact location and sampling devices to be used for each sample will be specified in each facility-specific SAP.

For each selected facility, a table will be constructed and incorporated into the facility-specific SAP to specify the number and type of field samples to be obtained, a site or unit-specific target analyte list, and required analytical methods. See Table B1-1. The information also will be used to determine the number and type of field and laboratory QA/QC samples required.

Table B1-1. Example Format For Specifying the Location, Type, and Number of Samples and Analyses

(*Note: The following table is an example of the type of information required for each site-specific SAP. Each site-specific SAP will include a site-specific target analyte list, target quantitation limits, method performance criteria, and proposed analytical methods.*)

Facility Name	Media/Matrix Type, Sample Location	Site-Specific Target Analyte List and Analysis Method							Total Samples
		Metals	Ext Org/Pest/PCBs	Volatiles	Cyanide	Water Qual Param.			
To be specified in facility-specific SAP	Influent								
	Wastewater								
	Sludge								
	Effluent								
	Ground Water								
	Leachate								
Totals									

At each selected facility, the spatial boundary for characterization of individual surface impoundments will be defined, at a minimum, by its dikes or topographic depression including influent and effluent points, leachate in the leachate collection system, ground water from well located at the unit boundary, and sludge in the impoundment or actively being removed from the impoundment. Due to budgetary and practical constraints, the boundary of the fields sampling and analysis program will not include affected media such as soil, surface water, biota, vegetation, air. All sampling and analysis data will be critical measurements (i.e., required to meet project objectives), unless otherwise specified by the SAP.

B1.4 Standard Content and Format for the Facility-Specific SAPs

This section establishes the general content and format for the facility-specific SAPs. Each facility-specific SAP will address the following elements and/or topics, providing cross-reference to this QAPP as appropriate:

Proposed Content for Facility-Specific SAPs

Title Page, Approvals, and Table of Contents

1. Project Description
   - 1.1 Problem Definition/Background
   - 1.2 Project/Task Description
   - 1.3 Facility Description

2. Project Organization and Responsibilities
   - 2.1 Project Management and QA Staff
   - 2.2 Health and Safety Officer
   - 2.3 Site Safety Coordinator
   - 2.4 Field Team
   - 2.5 Laboratory Coordinator
   - 2.6 Technical Staff
   - 2.7 Analytical Laboratory

3. Quality Objectives and Criteria for Measurement Data (DQOs and MQOs)

4. Field Procedures
   - 4.1 Unit-Specific Sampling Strategy (including sampling locations)
   - 4.2 Sampling Equipment
   - 4.3 Sample Containers
   - 4.4 Sample Preservation
   - 4.5 Sample Numbering
   - 4.6 Sample Labels
   - 4.7 Decontamination Procedures
   - 4.8 Sample Packaging and Shipping

5. Sample Custody and Transport

6. Analyses Required and Site-Specific QA/QC Procedures
   - 6.1 Facility-Specific Target Analyte List
   - 6.2 Required Methodologies
   - 6.3 Field QA/QC Procedures
   - 6.4 Laboratory QA/QC Procedures

7. Calibration Procedures and Frequency

Attachments (e.g., Health and Safety Plan, Standard Operating Procedures)

B2 Sampling Methods Requirements

This section describes procedures for collecting samples, sampling methods and equipment, sample preservation requirements, decontamination procedures, and management of investigation-derived waste. If any problems occur during sampling, the Field Team Leader or his/her designee will be responsible for corrective action decisions. The facility-specific SAPs will address any other sampling requirements on a facility-specific basis. For example, sample collection for analysis by the TCLP may be requested by EPA to evaluate the leaching potential of sludges removed from a closed surface impoundment.

B2.1 Sample Collection Strategy

The media to be sampled will include wastewater influent to impoundments; wastewater in impoundments; sludge in impoundment (e.g., being removed from active impoundments, or removed from closed impoundments); wastewater effluent from impoundments; and leachate from leachate collection systems. The following subsections describe the sample collection and field preparation procedures.

Ideally, samples of wastewater will be obtained using a sampling strategy similar to that used by the facility to generate wastewater characterization data. However, the ability to implement this strategy at any given facility will depend upon (1) the availability of facility-specific information on their sampling procedures, and (2) practical constraints such as time available on site. If composite sampling is appropriate (e.g., 8-hour or 24-hour composites), then the SAIC field team will deploy ISCO or similar type of auto-samplers. In the absence of information on the facility's sampling protocol, "grab" sampling will be used. Grab samples consist of either a single discrete sample or individual samples collected over a period of time not to exceed 15 minutes. The grab sample should be representative of the wastewater conditions at the time of sample collection. The total volume of material required for a given sample will depend on the type and number of analyses to be performed (see Section B2.4.1).

B2.1.1 Wastewater

Ideally, wastewater samples should be collected where the wastewater is well mixed. The sample should be collected near the center of the flow channel, at approximately 40 to 60 percent of the water depth, where the turbulence is at a maximum and the possibility of solids settling is minimized. Skimming the water surface or dragging the channel bottom should be avoided. Allowances, however, should be made for fluctuations in water depth due to flow variations. For instances in which the flow volume is sufficiently low, the sampling approach will attempt to capture the entire width of the flow for a fraction of the time.

<u>Influent</u>

Influent wastewaters are preferably sampled at locations of turbulent flow in order to ensure good mixing; however, in some instances the most desirable location may not be accessible. The preferred sampling location, which may include multiple influents, will be established in the facility-specific SAPs after consideration of the configuration of each facility.

Effluent

Effluent samples should be collected at the point of discharge from the impoundment of interest.

Note that for the purpose of the Surface Impoundment Study, "effluent" also can include physical removal of sludge (see also Section B2.1.3).

Wastewater in Impoundments

Surface impoundments include natural depressions, manmade excavations, or diked areas that contain an accumulation of liquids or wastes containing free liquids and solids. Examples of surface impoundments are ponds, lagoons, and holding, storage, settling, and aeration pits. Surface impoundments may contain several phases such as floating solids, liquid phase(s), and sludges. They can vary in size, shape, and waste content, and may vary in distribution of hazardous constituents and characteristics (strata). The appropriate sampling strategy and device for sampling specific surface impoundments will depend on accessibility of the waste, the type and number of phases of the waste, the depth, and chemical and physical characteristics of the waste.

Because of the potential danger of sampling surface impoundments suspected of containing elevated levels of hazardous constituents, the SAIC field team will never attempt to sample surface impoundments from a boat. For practical and safety reasons, all sampling will be conducted from the banks, piers, or catwalks at surface impoundments. Any exception must be approved by the appropriate site safety officer.

Supplementary Data Collection

While conducting wastewater sampling, the following information will also be obtained (if applicable):

- Field measurements -- using a portable water quality monitoring instrument, obtain measurements of pH, dissolved oxygen, conductivity, and temperature. If monitoring wells are sampled, then depth and water level measurements also will be obtained using an electronic water level indicator.

- Flows associated with the samples collected -- instantaneous flows with grab samples (see Section B2.2).

All observations, measurements, diagrams, etc., will be entered in bound field logbooks or attached thereto (where applicable as specified in Section A9).

B2.1.2 Leachate and Ground Water

Surface impoundments may generate leachate below the unit. Characterizing the leachate actually generated at operating and other waste-management facilities is a critical part of understanding waste constituent leaching into ground water.

To obtain samples of leachate, site-specific sampling locations will be selected by using the expertise of the site or facility representatives. The sampling team will consult knowledgeable facility representatives and obtain samples at locations believed to contain leachates. The sampling team will then collect samples from these locations which may include leachate sumps, manholes, and leachate tanks associated with a leachate collection system.

If it is not possible to obtain a sample of leachate, and there are one or more monitoring wells placed at or near the unit boundary designed to monitor ground water in the uppermost aquifer, then the field team may collect samples from these wells as an alternative to sampling of leachate. To obtain samples of ground water, the SAIC field team will follow the guidance in EPA's *RCRA Ground-Water Monitoring: Draft Technical Guidance* (USEPA 1992a).

B2.1.3 Sludge

Surface impoundments may contain a solid phase (sludge) that has settled onto the bottom of the unit. Sludge means any solid, semisolid, or liquid waste containing five weight percent or more solids, and that is generated in the course of treating or managing wastewater. There are two sources from which sludge samples may be obtained: (1) sludge within an active impoundment, or actively being removed from an impoundment, and (2) sludge removed from a closed surface impoundment.

Samples of sludge will be grab samples.

B2.2 Flow Measurements

If available, SAIC field staff will use existing facility primary flow devices and flow measurement systems to obtain flow measurement at the time of sampling. One limitation of this strategy is that the field team will not be able to verify the accuracy of a specific device or system.

If an existing system is not in place, or there is some question regarding its accuracy, SAIC will attempt to estimate discharge flow rates via one of two methods:

1. Small water flows from pipes, culverts, and spillways will be measured using the bucket and stopwatch method. It is accurate and easy to use. The only equipment required to make this measurement is a calibrated container (bucket, drum, tank, etc.) and a stopwatch. A minimum of 10 seconds to fill the container is recommended. Three consecutive measurements should be made, and the results should be averaged. If the bucket is not already calibrated, this will be done by marking with a permanent marker on the side of the bucket as sequential additions (i.e., liters) of water are poured in. The bucket will be placed in the waste stream and allowed to fill while being timed with the stopwatch. The final volume of the bucket will be measured and flow calculated as a function of volume per unit time (i.e., liters/minute). Flows will be measured and recorded in triplicate so that an average can be calculated.

2. Flows in open channels will be estimated by using one of several methods described in the ISCO *Open Channel Flow Measurement Handbook*. All flow

measurements should be considered estimates. It may not be possible to accurately estimate overflow or 'spread' flows.

B2.3 Sampling Equipment

Sampling devices selected for use at a specific facility may differ from those identified in the table depending on facility-specific circumstances. Table B2-1 outlines the type of waste stream, the waste characteristics, the sampling locations, and the sampling equipment that would be used for each type of waste that might be sampled.

Table B2-1. Sampling Equipment

Waste Stream	*Waste Description*	*Point of Sample Collection*	*Sampling Equipment*
Influent and Effluent Wastewater	Aqueous Liquid	Pipe, point-source discharge	Sample container, swing jar sampler, dipper or pond sampler (per ASTM D5013 and D5358), or displacement pump
Wastewater in Impoundment	Aqueous Liquid	Surface Impoundment	Bacon bomb, dipper, liquid grab sampler, Kemmerer sampler
Leachate	Aqueous Liquid	Leachate collection system	Sample container, COLIWASA, dipper, or displacement pump
Ground Water	Aqueous Liquid	Monitoring well at unit boundary (if leachate sample not available)	Submersible pump (e.g., Grunfos Red–Flo2) or bailer (depending on constituents of interest)
Sludge	Sludge/Solids	Surface impoundment or as generated upon removal (if possible)	Lidded sludge/water sampler, scoop, dredge, core, or syringe sampler

B2.3.1 Equipment for Sampling Wastewater

The sampling techniques will include "manual" (rather than automatic) procedures. Manual sampling is normally used for collecting grab samples and/or for immediate *in-situ* field analyses. However, it can also be used in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to evaluate unusual waste stream conditions.

Influent and Effluent

The simplest method to manually collect a sample of influent and effluent is to use the actual sample container which will be used to transport the sample to the laboratory. This eliminates the possibility of contaminating the sample with intermediate collection containers. If the water or wastewater stream cannot be physically reached by the sampling personnel or it is not safe to reach for the sample, an intermediate collection container may be used, from which the sample can be redistributed to other containers. For this project, intermediate devices could

include a dipper (e.g., on an extension pole) or bucket (e.g., on a rope). If this is done, however, the container used to collect the sample must be properly cleaned and must be made of a material that meets the requirements of the parameter(s) being investigated. To the extent practical and possible, samples for oil and grease, phenols, volatile organic compounds, and sulfides analyses must always be collected directly into the sample container.

In some cases it may be best to use a pump, either power or hand operated, to withdraw a sample from the water or wastewater stream. If a pump is used, it is imperative that all components of the pump that come in contact with the sample are properly cleaned to insure the integrity of the sample.

In general, samples are manually collected by first selecting a location in the wastestream that is well mixed and then by dipping the container in the water or wastewater stream so the mouth of the container faces upstream. The container should not be overfilled if preservatives are present in the container.

Wastewater in the Impoundment

Surface impoundments can range from several hundred to several million gallons in capacity. Due to their large size, they are usually open to the atmosphere rather than covered. Sampling of an impoundment from a "random" point may be difficult, except near its edges or from walkways that extend over the impoundment. "Off-shore" sampling will not be conducted for the SIS sampling program, rather, the field team will use equipment such as a bacon bomb, dipper, liquid grab sampler, or Kemmerer sampler as appropriate and as field and unit conditions dictate.

B2.3.2 Equipment for Sampling of Leachate from the Leachate Collection System

If a facility collects leachate and the leachate is available in a tank or sump, then the field team will collect samples using devices suitable for tank sampling. These devices may include the sample container, dipper, displacement pump, or COLIWASA. The exact device will be selected based on facility-specific circumstances and will be specified in the facility-specific SAP.

B2.3.3 Equipment and Procedures for Sampling Ground Water

Before ground-water sampling begins, wells shall be inspected for signs of tampering or other damage. If tampering is suspected (i.e., casing is damaged, lock or cap is missing), this shall be recorded in the field log book and reported to the SAIC Field Team Leader who in turn will notify the SAIC WAM. Wells that are suspected to have been tampered with shall not be sampled until the SAIC WAM has discussed the matter with the EPA WAM.

When the casing cap is removed to measure water level or collect a sample, the air in the breathing zone shall be checked with an organic vapor meter. Procedures in the Health and Safety Plan (HSP) shall be followed when high concentrations of organic. Air monitoring data shall be recorded on the field log book.

Sampling activities will include obtaining water level measurements, purging of the well prior to sampling, and sample collection. Water level measurements will be measured using an electric water level indicator following procedures described in EPA guidance (USEPA 1992a) or as specified in the facility-specific SAP. Following water level measurement, the total depth of the well from the top of the casing shall be determined using a weighted tape or electric sounder and recorded on the log book.

Wells will be purged and sampled using either a submersible pump or a bailer. A submersible pump, such as a centrifugal or bladder pump capable of low-flow rates, is preferred when the constituent of interest include volatile and/or low concentration metals (Puls and Barcelona 1996).

B2.3.4 Equipment for Sampling of Sludge/Solids

Sludge present within active impoundments will be sampled using a dredge. Sludge being removed from an impoundment will be sampled using the sample container, a scoop, or a dipper, as appropriate. Sludge removed from a closed surface impoundment, but actively managed in another unit, will be sampled using a lidded sludge/water sampler, scoop, or coring device, as appropriate. The exact device will be selected based on facility-specific circumstances and will be specified in the facility-specific SAP.

B2.4 Sample Containers, Preservation, and Holding Times

The following sections describe the sample containers, preservation protocols, and sample holding times necessary for the SIS field sampling and analysis study.

B2.4.1 Sample Containers

All required sample containers will be provided to SAIC by the laboratory and will be in possession of the field team prior to site access. The sample containers are purchased as pre-cleaned containers from a commercial vendor and come with certificates (held by the analytical lab) demonstrating that each container lot is free of contaminants. During sample collection, each container will be filled to near capacity. In the event volatiles analyses are necessary, however, these samples will be collected in containers without head-space.

The sample media expected for this project include water, sludges, and leachate. The type of sample containers to be used for each matrix type and analysis are shown in Tables B2-2 and B2-3.

Table B2-2. Sample Containers, Preservation, and Holding Times for Wastewater and Leachate

Parameter	*Container Type and Size*[1]	*Number of Sample Bottles*[2]	*Preservation*[3]	*Holding Time*[4]
Volatile Organics (no residual chlorine present)	B	3 for purgeable, 3 additional for non-purgeable (if needed)	Cool to 4 °C and adjust pH to less than 2 with H_2SO_4, HCl, or solid $NaHSO_4$. (See also footnote 5.)	14 days
Volatile Organics (WITH residual chlorine present)	B	3	Collect sample in a 125-mL container pre-preserved with 4 drops of 10% sodium thiosulfate solution. Gently swirl to mix sample and transfer to a 40-mL VOA vial. Cool to 4 °C and adjust pH to less than 2 with H_2SO_4, HCl, or solid $NaHSO_4$. (See also footnote 5.)	14 days
Semivolatile Organics	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
Dioxins/Furans	A	2	Cool $\leq$4 °C	Not Applicable
Organics by HPLC HPLC/TS/MS	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
Organochlorine Pesticides	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
PCBs	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
Organophosphorus Compounds	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
Chlorinated Herbicides	A	3	Cool to 4 °C 0.008% $Na_2S_2O_3$	7 days until extraction 40 days to analysis
Metals	C	2	$HN0_3$ to pH <2. Cool to 4 °C	28 days Hg 180 days all other metals
Hexavalent, Chromium	C	1	Cool to 4 °C	24 hours to analysis
Cyanide, Total and Amenable to Chlorination	C	2	Cool to 4 °C. Adjust pH>12 with 50% NaOH.	14 days to analysis
Fluoride, Perchlorate	C	1	Cool to 4 °C	Perchlorate ASAP after collection Fluoride 28 days

Table B2-2. Sample Containers, Preservation, and Holding Times for Wastewater and Leachate

Parameter	*Container Type and Size*[1]	*Number of Sample Bottles*[2]	*Preservation*[3]	*Holding Time*[4]
Acrolein	A	3	Cool to 4 °C, 0.008% $Na_2S_2O_3$ to remove free chlorine. Adjust pH to 4-5.	14 days to analysis
Pronamide	A	3	Cool to 4 °C	7 days until extraction 40 days to analysis
Sulfide	C	1	Cool to 4 °C, add zinc acetate.	7 days to analysis

Footnotes to Table B2-2:

1. Highly contaminated samples can be collected in smaller containers and/or more than one type of analyses can be performed from a single container except for volatiles. The containers noted here are a suggested minimum. If samples are sent to more than one laboratory, more sample containers and sizes may be employed.
2. The number of containers listed is also sufficient for required MS/MSD analyses.
3. Samples are processed for shipment and immediately cooled on ice. On receipt at the laboratory, all samples are immediately transferred to a refrigerator at $\leq$4 °C.
4. Holding times shall commence from the date of sample collection. Samples shall be submitted to the laboratory no later than 24 hours from the time of sample collection.
5. If, upon addition of acid preservative, effervescence occurs in the samples, then those samples should be discarded and new sample should be taken and held at 4±2 °C without the addition of acid preservative.

Container Key

A 1-L wide mouth amber glass jar with PFTE-lined cap.
B 40-mL amber glass vial with PTFE-lined septa cap.
C 1000-mL HDPE plastic bottle and lid.
D 500-mL wide mouth amber glass container with PTFE-lined cap.

Table B2-3. Sample Containers, Preservation, and Holding Times for Sludge/Solids

Parameter	*Container Type and Size*[1]	*Number of Sample Bottles*[2]	*Preservation*[3]	*Holding Time*[4]
Volatile Organics	A	2	Cool to 4 °C	14 days
Semivolatile Organics	B	2	Cool to 4 °C	14 days to extraction 40 days to analysis
Dioxins/Furans	B	2	Cool ≤4 °C	Not Applicable
Organics by HPLC HPLC/TS/MS	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
Organochlorine Pesticides	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
PCBs	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
Organophosphorus Compounds	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
Chlorinated Herbicides	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
Metals	B	1	Cool to 4 °C	28 days Hg 180 days all other metals
Hexavalent, Chromium	B	1	Cool to 4 °C	One month to digestion Analysis 4 days after extraction
Cyanide, Total and Amenable to Chlorination	B	1	Cool at 4 °C	14 days to analysis
Fluoride, Perchlorate	C	1	Cool to 4 °C	Perchlorate ASAP after collection Fluoride 28 days
Acrolein	B	2	Cool to 4 °C	14 days to analysis
Pronamide	B	2	Cool to 4 °C	14 days until extraction 40 days to analysis
Sulfide	B	1	Cool to 4 °C	7 days

Footnotes to Table B2-3:

1. Highly contaminated samples can be collected in smaller containers and/or more than one type of analyses can be performed from a single container except for volatiles. The containers noted here are a suggested minimum. If samples are sent to more than one laboratory, more sample containers and sizes may be employed.
2. The number of containers listed is also sufficient for required MS/MSD analyses.
3. Samples are processed for shipment and immediately cooled on ice. On receipt at the laboratory, all samples are immediately transferred to a refrigerator at $\leq 4\ ^{o}C$.
4. Holding times shall commence from the date of sample collection. Samples shall be submitted to the laboratory no later than 24 hours from the time of sample collection.

Container Key

A 40-mL amber glass vial with PTFE-lined cap.
B 250-mL wide mouth amber glass container with PTFE-lined cap.
C 1-L wide mouth amber glass container with PTFE-lined cap.

For organic analyses, a matrix spike and matrix spike duplicate analysis (MS/MSD) will be prepared and analyzed for each analytical method and each sample matrix at a frequency of at least 5% of the samples of the same matrix. For inorganic analyses, a matrix spike and a duplicate sample analysis will be performed. As necessary, extra sample volume will be obtained for those samples designated for spiking or duplicate analyses. Samples identified for MS/MSD or spike and duplicate analyses will be labeled and specified on the chain-of-custody form.

Equipment rinsate blanks will be prepared during the sampling event from equipment decontamination procedures. These samples shall be prepared for each matrix (i.e., liquid, sludge, and solid) by on-site collection of the respective sample collection equipment rinses prior to use. For samples collected directly into the sample container, a field blank may be prepared from reagent water carried to the site.

B2.4.2 Sample Preservation

All samples will be physically preserved by storing and shipping the samples in coolers, packed in ice. A cooler temperature blank will be prepared for every sampling event. The target range for the temperature in the cooler is 4±2°C. If the temperature is outside of that range upon receipt at the laboratory, then the laboratory will note the deviation and immediately contact the SAIC Laboratory Coordinator.

Analyte-specific preservation requirements are outlined in Table B2-2 and Table B2-3.

B2.4.3 Sample Holding Times

Holding times are specified in Table B2-2 and Table B2-3.

B2.5 Decontamination Procedures and Materials

Decontamination of sampling equipment refers to the physical and chemical steps taken to remove any chemical or material contamination. Equipment decontamination helps prevent sampling bias. All equipment that comes in contact with the sampled material should be free of components that could influence (contaminate) the true physical or chemical composition of the material. Equipment decontamination also prevents cross-contamination of samples when the equipment is used to collect more than one sample.

This section provides project-specific decontamination procedures. The following procedure will be used to decontaminate sampling devices for the SIS sampling program. It is suitable for use when collecting samples for trace organic or inorganic constituent analyses:

1. Clean the device with tap water and soap, using a brush if necessary to remove particulate matter and surface films.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with analyte- or organic-free water.

4. Rinse thoroughly with solvent. Do not solvent-rinse PVC or plastic items.

5. Rinse thoroughly with analyte- or organic-free water, or allow equipment to dry completely.

6. Remove the equipment from the decontamination area. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

The specifications for the cleaning materials are as follows:

- "Soap" will be Alconox® or Liquinox®. It will be kept in clean plastic, metal, or glass containers until used and poured directly from the container when in use.

- "Solvent" will be pesticide-grade isopropanol. It must be stored in the unopened original containers until used. It will be applied using PTFE squeeze bottles. For equipment highly contaminated with organics (such as oily waste), a laboratory-grade hexane may be a more suitable alternative to isopropanol.

- "Tap water" may be used from any municipal water treatment system or drinking water purchased locally. Use of an untreated potable water supply is not an acceptable substitute. Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose or tap.

- "Analyte-free water" (deionized water) or "organic- or analyte-free water" will be ASTM Type II reagent grade water or laboratory-grade HPLC water. It will be purchased from a laboratory supply vendor and stored in clean glass, PTFE, or stainless steel containers. It will be applied using PTFE squeeze bottles or other portable system.

Facility permission to discharge wastewater collected from on-site decontamination activities to the facility wastewater treatment system will be obtained prior to sampling.

B2.6 Management of Investigation-Derived Waste

Decontamination will generate a quantity of wastes called investigation-derived waste (IDW). IDW generated from sampling will consist of soiled/contaminated personal protective equipment (PPE) and decontamination waste water. If possible, provisions for on-site disposal of investigation-derived waste such as excess sample volume, gloves, and protective clothing will be obtained from the appropriate facility personnel. The SAIC field team will attempt to minimize the generation of hazardous IDW and keep it separated from nonhazardous IDW. The field team will control the volume of spent solvents during equipment decontamination by applying the minimum amount of liquid necessary and capturing it separately from the nonhazardous washwater.

Management of IDW will be performed in accordance with EPA guidance provided in *Management of Investigation-Derived Wastes* (USEPA 1992b). During development of facility-specific SAPs, the project team will attempt to determine in advance whether any special IDW management issues may arise at a particular facility (for example, due to the presence of dioxins). If any hazardous waste is generated by the field team, SAIC will prepare a waste profile and contract with a waste hauler to properly transport and dispose of the waste, however, an EPA representative will sign the manifests as the "generator" of the IDW.

B3 Sample Handling and Custody Requirements

This section describes the requirements and provisions for sample handling and custody in the field, laboratory, and transport. These requirements include procedures for sample numbering, sample labels, sample packaging, chain-of-custody (C-O-C) records, sample transfer and shipment and sample custody in the laboratory. Additional provisions may be included in the facility-specific SAPs, as necessary.

B3.1 Sample Numbering

Samples must be uniquely identified. This will be accomplished through the assignment of sample identification numbers that will be used to:

1. Eliminate sample mixup

2. Cross-reference field and laboratory information

3. Help to avoid analyst bias by keeping sample identities (especially replicates and blanks) "blind" to the analyst.

The sample identification numbers will be recorded in indelible ink on the bottle label, field logbook, and C-O-C form. The label must include at least the following: name of collector, date and time of collection, place of collection, and the collector's sample number which uniquely identifies the sample.

The facility-specific sample numbering scheme will be detailed in each facility-specific SAP.

B3.2 Sample Labels

At the time of collection, each sample will be labeled. The label (see Figure B3-1 for an example) will be completed in indelible ink and contain the following information:

- Sample number
- Analytes to be determined
- Date and time of sample collection
- Preservation used (if any), storage conditions
- Name or initials of collector.

SAMPLE NO: _____
ANALYSIS: _____
PRESERVATIVE: _____
SAMPLER: _____
DATE: _____ TIME: ____

Figure B3-1. Example of a Sample Label

B3.3 Sample Packaging

Samples must be packaged and labeled for shipment in compliance with current and applicable U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) dangerous goods regulations. Any additional requirements stipulated by the overnight carrier must be followed. The packaging and labeling requirements will be documented in each facility-specific SAP.

After being tightly sealed, each sample container will be wiped clean, labeled, and enclosed in a self-sealing bubble wrap bag. VOA vials, if necessary, will be packaged individually in self-sealing bubble wrap bags which in turn are grouped in pairs by sample number and placed in separate self-sealing plastic bags. For overnight shipment, each individually wrapped sample is placed in a metal or plastic cooler, lined with two 6-mil thick plastic bags and bubble wrap, and partially filled with vermiculite.

After the sample containers are sufficiently packaged, the inner 6-mil plastic bag will be sealed around the samples by twisting the top and securely taping the bag closed. Ice (sealed in bags) will be placed between the inner and outer plastic bags, with the latter taped and sealed closed. A temperature blank will be included with each cooler in order to record the cooler temperature upon laboratory receipt. Chain-of-custody records will be enclosed in a waterproof self-sealing plastic bag taped to the underside of the cooler lid. The cooler is sealed with strapping tape and affixed with custody seals (Figure B3-2). The laboratory address is placed on the top of the cooler using the appropriate Federal Express airbills.

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE No. | DATE
SIGNATURE
PRINT NAME AND TITLE (*INSPECTOR, ANALYST or TECHNICIAN*)

SEAL BROKEN BY
DATE

EPA FORM 1500-2(R7-75)

Figure B3-2. Example of a Custody Seal

B3.4 Field Chain-of-Custody Record

Field chain-of-custody (C-O-C) will be maintained for all samples collected. Documentation of all field activities is required to provide backup for any deviations from the SAP. Analytical data generated in support of the SIS must be able to withstand legal scrutiny; therefore, all activities associated with the sample must be able to withstand the same scrutiny. A major part of providing this data defensibility is evidence that samples have not been tampered with at any time. This evidence is provided through strict adherence to C-O-C protocols, including the following:

- Sample identification
- C-O-C seals
- C-O-C forms
- Personal custody
- Transfer of custody.

A sample is considered to be in an individual's custody if the sample is (1) in the physical possession or view of the responsible party, (2) secured to prevent tampering, or (3) placed in a restricted area by the responsible party. To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a C-O-C record will be filled out for each sample set at each sampling location. Chain-of-custody records will be used to document sample custody transfer from the field to the laboratory. The C-O-C record must be filled out completely and accurately since this form provides documentation for what was collected in the field and the analyses to be completed in the laboratory. The C-O-C record, shown in Figure B3-3,will include the following information:

- Project name/code
- Site/facility name
- Sample number
- Sample location
- Sample type or matrix
- Collection date and time
- Number of containers for each sample
- Analysis required including appropriate method reference
- Shipment number (commercial transportation)
- Shipping address of the laboratory
- Date, time, and method of shipment
- Remarks/comments
- Signature of Field Team Leader or his/her designee
- Notation of MS/MSD next to sample description.

Figure B3-3. Chain-of-Custody Record

Science Applications International Corporation
An Employee-Owned Company

Chain-of-Custody Record

Date_____ Page_____ of_____

Shipment No.

Name_____
Address_____
Phone Number_____
Project Manager_____
Project Name_____
Job/P.O. No._____
Sampler (Signature) (Printed Name)

Laboratory No.	Matrix	Sample No.	Date	Time	Site/Zone

Requested Parameters

NO. OF CONTAINERS

Laboratory Name_____
Address_____
Phone_____
Contact Name_____

OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS

Relinquished By	Date	Received By	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	
Relinquished By	Date	**Received By**	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	

Total Numbers of Containers:

Instructions

1. Fill out form completely except for shaded areas (lab use only).
2. Complete in ballpoint pen. Draw one line through errors and initial.
3. Request analyses using EPA method numbers only. Consult the project QAPP for instructions. Complete as shown.
4. Reference all field QC samples to the applicable site or zone.
5. Note all applicable preservatives.
6. Group all sample containers and requested analyses from one sampling location together. Do not list individually.

Shipment Method:

Air Bill No.: _____

SAIC EHSG Location (circle)

Bothell/EHSG
18702 North Creek Parkway, Suite 211, Bothell, WA 98011
(206) 485-2818

Denver/EHSG
999 18th Street, North Tower, Suite 855, Denver CO 80202
(303) 292-2074

Paramus/EHSG
One Sears Drive, Paramus, NJ 07652
(201) 599-0100

San Diego/EHSG
4224 Campus Point, Building 3, San Diego, CA 92121
(619) 535-7438

San Francisco/EHSG
20 California Street, Suite 400, San Francisco, CA 99111
(206) 747-7899

Washington, DC/EHSG
7600-A Leesburg Pike, Falls Church, VA 22043
(703) 821-4600

Upon completion of the C-O-C form, the Field Team Leader or his/her designee will sign, date, enter the time, and confirm completeness of all descriptive information contained on the C-O-C record. Each individual who subsequently assumes responsibility for the samples will sign the C-O-C record and indicate the reason for assuming custody. Any changes made to the form will be initialed by the person making the changes. The field C-O-C record will terminate upon laboratory receipt of samples. The Field Team Leader will retain a copy of the C-O-C record for the program files.

B3.5 Sample Transfer and Shipment

Samples will be accompanied by an approved C-O-C at all times. When the possession of samples is transferred, both the individual relinquishing the samples and the individual receiving the samples will sign, date, and note the time on the C-O-C document. This record represents the official documentation for all transfers of the sample custody until the samples have arrived at the laboratory. The original form of the C-O-C record will accompany each sample cooler shipment. A copy of the C-O-C record will be retained by the Field Team Leader for inclusion to the project file.

All samples will be shipped under the exclusion allowed for transporting laboratory samples in 40 CFR 261.4(d). Samples will be packaged and labeled for shipment in compliance with current and applicable U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) dangerous goods regulations. Any additional requirements stipulated by the overnight carrier (Federal Express) will be followed.

All samples will be shipped from the site to the laboratory via overnight delivery. All necessary Federal Express labeling and dangerous goods shipment forms will be in the possession of the Field Team Leader. Prior to the sampling event, and as documented in the facility-specific field sampling and analysis plan, the field team will identify the exact location and phone number of the nearest Federal Express office or other authorized Federal Express package shipping locations. Upon shipment, the Field Team Leader will advise the SAIC laboratory coordinator of the shipment.

B3.6 Laboratory Sample Custody

Samples will arrive at the laboratory via overnight delivery by Federal Express. Upon receipt of the samples, the coolers will be checked for intact custody seals. The coolers will be opened and the internal cooler temperature will be recorded from a temperature blank shipped with each cooler. The objective is to maintain cooler temperatures to as close to 4°C as possible. The samples will then be unpackaged and the information on the accompanying chain-of-custody records examined. If the samples delivered match those described on the C-O-C record, the laboratory sample custodian will sign the form and assume responsibility for the samples. If problems are noted with the sample shipment, the laboratory custodian will sign the C-O-C form and record problems in the "Remarks" box. The laboratory will have a standard operating procedure (SOP) for sample receipt, storage, and custody.

Any missing samples, missing labels, broken sample bottles, or unpreserved samples will be noted on the C-O-C record. If there are problems with any individual samples, the sample custodian will inform the Laboratory Coordinator of such problems. The Laboratory Project Manager will then contact the SAIC Laboratory Coordinator to determine a viable solution to the problem.

All samples then will be logged into a sample receipt logbook or the computerized laboratory information system. The following information will be documented:

- Date and time of sample receipt
- Project number and name
- Field sample number
- Laboratory sample number (assign during log-in procedure)
- Sample matrix
- Analytical parameters
- Storage location
- Log-in person's initials.

All information relevant to the samples will be secured at the end of each business day. All samples will be stored in a designated storage refrigerator.

When sample custody is transferred between individuals and/or locations, the coolers containing the samples are sealed with a custody seal. This seal cannot be removed or broken without destruction of the seal, providing an indicator that custody was not violated.

B4 Analytical Method Requirements

This section provides a general overview of the requirements for the analytical methods that will be employed for the surface impoundment study, as well as the procedures that will be applied to subsample the field samples that are collected. The specifics of this section may be superseded by facility-specific considerations, as addressed by the facility-specific sampling and analysis plan (SAP).

This section provides a preliminary list of the constituents of concern for the study. The list is based on the comprehensive list of 256 constituents provided in Appendix 2 of the *Survey of Surface Impoundments* (USEPA 1999). Tables B4-1, B4-2, and B4-3 in this section list the analytes categorized by the relative difficulty of obtaining useful analytical results for the types of samples to be collected in the SIS project.

Note that due to limited resources and the project schedule, no attempts will be made to develop any analytical methods specifically for this study to address any of the difficult-to-analyze constituents.

B4.1 Sample Subsampling and Preparation

The sections to follow provide procedures for sample subsampling and preparation in the laboratory.

B4.1.1 Laboratory Subsampling Procedures

The volume of either an individual sample or a composite sample submitted to the laboratory by the field personnel typically will exceed the volume required for analysis. Consequently, subsampling may be necessary.

A subsample is defined as *"a portion of material taken from a larger quantity for the purpose of estimating properties or the composition of the whole sample"* (ASTM D 4547-98). Taking a subsample may be as simple as collecting the required mass from a larger mass, or it may involve one or more preparatory steps such as grinding, homogenization, and/or splitting of the larger mass prior to removal of the subsample.

It is anticipated that samples for the SIS will include water and sludges and not granular material such as soil. As long as the materials submitted for analysis are liquid and/or fine-grained solids (i.e., sludges), there should be no need for grinding and particle-size reduction prior to subsampling and preparation of the analytical sample. The analysts should, however, follow subsampling procedures intended to minimize bias and imprecision that may be introduced by subsampling within the laboratory.

B4.1.2 Subsampling Liquids

In the case of subsampling a liquid, special precautions may be warranted if the liquid contains suspended solids and/or the liquid comprises multiple liquid phases. In practice, samples may contain solids and/or separate phases that are subject to gravitational action (Gy 1998). Even a liquid that appears clear (absent of solids and without iridescence) may not be "homogeneous."

Subsampling of liquids (containing solids and/or in multiple phases) can be addressed by using one the two following approaches:

1. Mixing the sample such that all phases are homogenized, collecting a subsample (using a pipette, for example), and analysis of the mixture.

2. Allowing all of the phases to separate, followed by subsampling and analysis of each phase separately.

The characteristics of the waste and the type of test must be considered. For example, *mixing of multi-phasic wastes to be analyzed for volatiles should be avoided due to the potential loss of constituents*. Some multi-phasic liquid wastes can form an emulsion when mixed. Others, in spite of mixing, will quickly separate back into distinct phases.

B4.1.3 Subsampling Mixtures of Liquids and Solids

If the sample is a mixture of liquids and solids that readily form separate phases, subsampling usually requires that the phases be separated. The separate phases are then subsampled individually. Subsampling of the liquid phase can be accomplished as described above, while subsampling of the solid phase should be done in the manner described for subsampling solids (see Section B4.1.4).

B4.1.4 Subsampling Solids

Subsampling of solids should be performed from relatively flat, elongated piles of the sample using a transversal subsampling technique that employs a sampling scoop or spatula and a flat working surface. *These procedures should only be used to prepare subsamples for analysis of nonvolatile constituents*. Specifically, Pitard (1993) recommends the following procedure:

- Empty the sample from the sample container onto a smooth and clean surface or appropriate material.

- Do not try to homogenize the sample, as this may promote segregation of particles.

- Reduce the sample by using a splitting technique until a sample 5 to 10 times larger than the analytical sample is obtained.

- Shape the remaining material into an elongated pile with uniform width and thickness.

- Using a flat spatula or scoop, take small increments all across the pile through the entire thickness.

- Reshape the pile perpendicular to its long axis, and continue to take increments across the pile until the appropriate sample weight is reached for the analytical sample.

B4.2 Analytical Methods

The SIS project will employ a performance-based approach to the analysis of project samples. To that end, this QAPP does not specify analytical methods that must be employed for the project. Rather, the list of potential constituents of concern are presented in Tables B4-1, B4-2, and B4-3, along with the carcinogenic-risk screening factors (CRSFs) or noncarcinogenic risk screening factors (NCRSFs) that have been estimated for each constituent in aqueous and sediment or sludge matrices.

SAIC has estimated the CRSF or NCRSF for each constituent using draft equations for the development of human health screening factors as presented in Table 2-1 of the *Surface Impoundment Study Technical Plan for Human Health and Ecological Risk Assessment*, (USEPA 2000). For the purposes of this QAPP and at EPA's direction, SAIC has considered only two exposure scenarios: direct ingestion of water derived from the impoundment and direct ingestion of sediments or sludges (denoted as "soil" in the equations below). The equations for CRSF for water and soil are given below.

$$CRSF_{water} = \frac{RC_c \cdot AT \cdot 365}{SF \cdot EF \cdot \left(\sum_{i=1}^{5} C \frac{IRW_i \cdot ED_i}{BW_i} \right)}$$

$$CRSF_{soil} = \frac{RC_c \cdot AT \cdot 365}{SF \cdot EF \cdot 10^{-6} \cdot \left(\sum_{i=1}^{5} \frac{IRS_i \cdot ED_i}{BW_i} \right)}$$

where:

CRSF = Carcinogenic risk screening factor. Units for water are mg/L and for soil (sediment) are mg/kg in the equations, and SAIC has converted these to µg/L and µg/kg for the purposes of this QAPP

RC_c = Risk criterion for carcinogens

AT = Averaging time (70 years) - the constant 365 converts years to days

SF = Slope factor in kg-day/mg

EF = Exposure frequency in days/year. SAIC has used 350 days/year, as described in the *Technical Plan* (USEPA 2000)

10^{-6} = Unit conversion factor (kg/mg)

IRW = Ingestion rate of matrix of interest (IRW for water, IRS for soil) for each age group (1 to 5) in liters/day or mg/day

ED = Exposure duration for age group (1 to 5) in years

BW = Body weight for age group (1 to 5) in kilograms

For those constituents which were not considered to pose a carcinogenic risk, the NCRSF was calculated using the matrix-specific equations show below.

$$NCRSF_{water} = \frac{RC_n \cdot BW_c \cdot RfD \cdot 365}{EF \cdot IRW_c} \qquad NCRSF_{soil} = \frac{RC_n \cdot BW_c \cdot RfD \cdot 365}{EF \cdot IRS_c \cdot 10^{-6}}$$

where:

NCRSF = Noncarcinogenic risk screening factor. Units for water are mg/L and for soil (sediment) are mg/kg in the equations, and SAIC has converted these to µg/L and µg/kg in Table B4-1 through B4-3 for the purposes of this QAPP

RC_n = Risk criterion for noncarcinogens

BW_c = Body weight for child (kg)

RfD = Reference dose (mg/kg-d)

EF = Exposure frequency in days/year - SAIC has used 350 days/year, as described in the screening assessment document

IRW = Ingestion rate of matrix of interest (IRW for water, IRS for soil) for each age group (1 to 5) in liters/day or mg/da

10^{-6} = Unit conversion factor (kg/mg).[1]

The resulting screening factors for water and sediment samples span 12 orders of magnitude, from $6x10^{-6}$ µg/L to $6.9x10^{6}$ µg/L, in aqueous samples and almost 11 orders of magnitude, from $6x10^{-2}$ µg/kg to $2.4x10^{9}$ µg/kg in sediments.

The screening factors calculated for this QAPP are subject to change based on a peer review of the equations that is currently underway. If the equations are changed in response to peer review and the changes are available prior to SAIC's preparation of the facility-specific SAPs, then SAIC will adjust the calculations accordingly and use the adjusted values to establish the target quantitation limits for the facility-specific constituents.

[1] The unit conversion factor was shown as 10^{-5} in the Technical Plan (USEPA, February 2000) due to a typographical error. The correct factor, 10^{-6}, is shown here.

The screening factors were tabulated and examined by SAIC relative to the capabilities of known analytical techniques. The constituents of concern were divided into three categories, based on the screening factors. Table B4-1 contains those constituents for which the screening factors for both water and sediment fall within the general magnitude that can be achieved using known, relatively routine preparative and analysis procedures. Table B4-2 contains those constituents for which the screening factor for water samples is believed to be well below the capabilities of such known methods, but for which the screening factor for sediment is within the capabilities of known methods. Table B4-3 contains those constituents which present analytical difficulties, as described later in this section.

Based on the data in Table A-1 of EPA's *Technical Plan* (USEPA 2000), some of the constituents of concern do not possess either a cancer slope factor or a non-cancer reference dose value necessary to calculate the risk screening factors presented in Tables B4-1, B4-2, and B4-3. The screening factor for these constituents was obtained from health-based concentrations as provided in the EPA Region 9 Preliminary Remediation Goals (PRGs). A screening factor listed as "NA" in the tables below indicates that a cancer slope factor or non-cancer reference dose value were not available and an associated concentration was not listed as a Region 9 PRG. Conversely, for some constituents both a carcinogenic and noncarcinogenic screening factor could be calculated since both a slope factor and reference dose value were available. For these constituents, the lowest of the calculated screening factor values is reported. Unless otherwise noted, the values listed in Tables B4-1, B4-2, and B4-3 are carcinogenic risk screening factors calculated for water and sludge according to EPA's *Technical Plan* (USEPA 2000).

The target quantitation limits provided in Tables B4-1 and B4-2 have been established by simply "rounding" the screening factor for the constituent down, and always down, to a concentration below the screening factor. As a result, when combined with other measurement performance objectives, the target quantitation limits will ensure that the constituents could be measured at or below the screening factor concentration. In performing this "rounding down," SAIC gave preference to values that are powers of 10 (e.g., 10, 100, 1000) or 5 times a power of 10 (e..g, 5, 50, 500). This was done to simplify the preparation of calibration standards by the laboratory.

Table B4-1
SIS Constituents With Screening Factors Within the Capabilities of Known Methods

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Acenaphthene	83-32-9	† 1,385	1,000	† 4,849,287	1,000,000
Acetaldehyde	75-07-0	# 1.8	1	# 10,900	10,000
Acetone	67-64-1	† 2,309	1,000	† 8,082,143	1,000,000
Acetonitrile	75-05-8	# 79.2	50	# 267,000	100,000
Acetophenone	98-86-2	† 2,309	1,000	† 8,082,143	1,000,000
Acrolein	107-02-8	† 461	100	† 1,616,429	1,000,000
Acrylamide	79-06-1	0.22	0.1	1,844	1,000
Acrylonitrile	107-13-1	1.8	1	15,370	10,000
Aldicarb	116-06-3	† 23.1	10	† 80,821	10,000
Aldrin	309-00-2	0.058	0.01	488	100
Allyl alcohol	107-18-6	† 115	100	† 404,107	100,000
Allyl chloride	107-05-1	# 1,820	1,000	# 30,400,000	1,000,000
alpha-Hexachlorocyclohexane [alpha-BHC]	319-84-6	0.156	0.1	1,317	1,000
Aniline	62-53-3	173	100	1,456,126	1,000,000
Anthracene	120-12-7	† 6,927	1,000	† 24,246,429	10,000,000
Antimony	7440-36-0	† 9.24	1	† 32,328	10,000
Arsenic	7440-38-2	0.657	0.5	5,533	1,000
Barium	7440-39-3	† 1,616	1,000	† 5,657,500	5,000,000
Benzene	71-43-2	34.0	10	286,204	100,000
Benzo(a)pyrene	50-32-8	0.135	0.1	1,136	1,000
Benzo(b)fluoranthene	205-99-2	1.35	1	11,369	10,000
Benzyl alcohol	100-51-6	† 6,927	5,000	† 24,246,429	10,000,000
Benzyl chloride	100-44-7	5.8	1	48,823	10,000
Benz[a]anthracene	56-55-3	1.35	1	11,369	10,000
Beryllium	7440-41-7	† 46.2	10	† 161,643	100,000
beta-Hexachlorocyclohexane [beta-BHC]	319-85-7	0.55	0.1	4,611	1,000
Bis(2-chloroethyl) ether	111-44-4	0.896	0.5	7,545	1,000
Bis(2-chloroisopropyl) ether	108-60-1*	14.1	10	118,570	100,000
Bis(2-ethylhexyl) phthalate	117-81-7	70.4	10	592,852	100,000
Bromodichloromethane	75-27-4	15.9	10	133,869	100,000
Bromoform	75-25-2	125	100	1,050,623	1,000,000
Bromomethane	74-83-9	† 32.3	10	† 113,150	100,000
Butyl benzyl phthalate	85-68-7	† 4,618	1,000	† 16,164,285	10,000,000
Cadmium	7440-43-9	† 11.5	10	† 40,411	10,000
Carbon disulfide	75-15-0	† 2,309	1,000	† 8,082,143	100,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Carbon tetrachloride	56-23-5	7.58	10	† 56,575	10,000
Chloral hydrate	302-17-0	# 73.0	50	# 122,000	100,000
Chloral	75-87-6	† 46.2	10	† 161,643	100,000
Chlordane, alpha & gamma isomers	57-74-9	2.8	1	23,714	10,000
4-Chloroaniline	106-47-8	† 92.4	50	† 323,286	100,000
Chlorobenzene	108-90-7	† 461	100	† 1,616,429	1,000,000
Chlorobenzilate	510-15-6	3.65	1	30,740	10,000
Chlorodibromomethane	124-48-1	11.7	10	98,808	10,000
Chloroethane	75-00-3	# 4.6	10	# 3,000	1,000
Chloroform	67-66-3	161	100	† 808,214	100,000
Chloromethane	74-87-3	75.8	10	638,455	100,000
Chloromethyl Methyl Ether	107-30-2	# 73,000	10,000	# 100,000,000	1,000,000
2-Chloronaphthalene	91-58-7	† 1,847	1,000	† 6,465,714	1,000,000
2-Chlorophenol	95-57-8	† 115	100	† 404,107	100,000
Chloroprene [2-Chloro-1,3-butadiene]	126-99-8	† 462	100	† 1,616,429	1,000,000
Chromium	7440-47-3	† 34,637	10,000	† 121,232,143	100,000,000
Chromium VI [Hexavalent Chromium]	18540-29-9	† 69.3	10	† 242,464	100,000
Chrysene	218-01-9	135	100	1,136,975	1,000,000
Cobalt	7440-48-4	† 1,385	1,000	† 4,849,286	1,000,000
Copper	7440-50-8	# 1,360	1,000	# 2,910,000	1,000,000
Cresols	1319-77-3	# 10.9	10	# 23,500	10,000
Cumene	98-82-8	† 2,309	1,000	8,082,143	1,000,000
Cyanide	57-12-5	† 462	100	† 1,616,429	1,000,000
Cyanide, Amenable	57-12-5	† 462	100	† 1,616,429	1,000,000
Cyclohexanol	108-93-0	# 7,300	5,000	# 12,200,000	10,000,000
Cyclohexanone	108-94-1	† 115,459	100,000	† 404,107,143	100,000,000
2,4-D	94-75-7	† 231	100	† 808,214	100,000
Diallate	2303-16-4	16.2	10	136,064	100,000
Dibenz[a,h]anthracene	53-70-3	0.135	0.1	1,136	1,000
1,2-Dibromo-3-chloropropane	96-12-8	0.7	0.1	5,928	1,000
Di-n-butyl phthalate	84-74-2	† 2,309	1,000	† 8,082,143	1,000,000
1,2-Dichlorobenzene	95-50-1	† 2,078	1,000	† 7,273,929	1,000,000
1,4-Dichlorobenzene	106-46-7	41.1	10	345,830	100,000
3,3'-Dichlorobenzidine	91-94-1	2.19	1	18,444	10,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Dichlorodifluoromethane [CFC-12]	75-71-8	† 4,618	1,000	† 16,164,286	10,000,000
1,2-Dichloroethane	107-06-2	10.8	10	91,207	10,000
1,1-Dichloroethylene	75-35-4	1.64	1	13,833	10,000
cis-1,2-Dichloroethylene	156-59-2	† 231	100	† 808,214	100,000
trans-1,2-Dichloroethylene	156-60-5	† 462	100	† 1,616,429	1,000,000
2,4-Dichlorophenol	120-83-2	† 69.3	10	† 242,464	100,000
1,2-Dichloropropane	78-87-5	14.5	10	122,057	100,000
cis-1,3-Dichloropropylene	10061-01-5	NA	10	NA	10
trans-1,3-Dichloropropylene	10061-02-6	NA	10	NA	10
Dieldrin	60-57-1	0.062	0.01	519	100
Diethyl phthalate	84-66-2	† 18,473	10,000	† 64,657,143	1,000,000
Dimethoate	60-51-5	† 4.62	1	† 16,164	1,000
3,3'-Dimethoxybenzidine	119-90-4	70.4	10	592,851	100,000
3,3'-Dimethylbenzidine	119-93-7	0.107	0.1	902	500
7,12-Dimethylbenz[a]anthracene	57-97-6	# 729,000	100,000	# 100,000,000	10,000,000
2,4-Dimethylphenol	105-67-9	† 462	100	† 1,616,429	1,000,000
3,4-Dimethylphenol	95-65-8	† 23.1	10	† 80,821	10,000
Dimethyl phthalate	131-11-3	# 365,000	100,000	# 100,000,000	10,000,000
Dinoseb	88-85-7	† 23.1	10	† 80,821	10,000
1,3-Dinitrobenzene	99-65-0	† 2.31	10	† 8,082	1,000
2,4-Dinitrophenol	51-28-5	† 46.2	10	† 161,643	100,000
2,4-Dinitrotoluene	121-14-2	† 46.2	10	† 161,643	100,000
2,6-Dinitrotoluene	606-20-2	† 23.1	10	† 80,821	10,000
1,4-Dioxane	123-91-1	89.6	50	754,538	100,000
Diphenylamine	122-39-4	† 577	500	† 2,020,536	1,000,000
1,2-Diphenylhydrazine	122-66-7	1.23	1	10,374	10,000
Disulfoton	298-04-4	† 0.923	0.5	† 3,233	1,000
Endosulfan	115-29-7	† 138	100	† 484,929	100,000
Endothall	145-73-3	† 462	100	† 1,616,429	1,000,000
Endrin	72-20-8	† 6.93	1	† 24,246	10,000
Epichlorohydrin	106-89-8	† 46.2	10	† 161,643	100,000
1,2-Epoxybutane	106-88-7	# 208	100	# 348,000	100,000
2-Ethoxyethanol	110-80-5	† 9,236	5,000	† 32,328,571	10,000,000
2-Ethoxyethanol acetate	111-15-9	† 6,927	5,000	† 24,246,429	10,000,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Ethyl acetate	141-78-6	† 20,782	10,000	† 72,739,286	10,000,000
Ethyl benzene	100-41-4	† 2,309	1,000	† 8,082,143	1,000,000
Ethyl ether	60-29-7	† 4,618	1,000	† 16,164,286	10,000,000
Ethyl methacrylate	97-63-2	† 2,078	1,000	† 7,273,929	1,000,000
Ethyl methanesulfonate	62-50-0	# 2.9	1	# 4,900	1,000
Ethylene glycol	107-21-1	† 23,091	10,000	† 80,821,429	10,000,000
Ethylene oxide	75-21-8	0.986	0.5	8,299	1,000
Ethylene thiourea	96-45-7	† 1.85	1	† 6,466	1,000
Ethylidene dichloride	75-34-3	† 2,309	1,000	† 8,082,143	1,000,000
Fluoranthene	206-44-0	† 924	500	† 3,232,857	1,000,000
Fluorene	86-73-7	† 924	500	† 3,232,857	1,000,000
Fluoride	16984-48-8	# 2,190	1,000	# 3,670,000	1,000,000
Formaldehyde	50-00-0	† 4618	1000	† 16,164,286	10,000,000
Furan	110-00-9	† 23.1	10	† 80,821	10,000
Furfural	98-01-1	† 69.3	50	† 242,464	100,000
Glycidylaldehyde	765-34-4	† 9.23	1	† 32,329	10,000
Heptachlor	76-44-8	0.219	0.1	1,844	1,000
Heptachlor epoxide	1024-57-3	0.108	0.1	912	500
Hexachloro-1,3-butadiene	87-68-3	† 4.62	1	† 16,164	10,000
Hexachlorobenzene	118-74-1	0.616	0.1	5,187	1,000
Hexachlorocyclopentadiene	77-47-4	† 161	100	† 565,750	100,000
Hexachlorodibenzo-*p*-dioxins**	34465-46-8	# 0.000025	0.00001	NA	0.005
Hexachlorodibenzofurans**	55684-94-1	# 0.000025	0.00001	NA	0.005
Hexachloroethane	67-72-1	† 23.1	10	† 80,821	10,000
Hexachlorophene	70-30-4	† 6.92	1	† 24,246	10,000
Indeno(1,2,3-cd) pyrene	193-39-5	1.35	1	11,369	10,000
Isobutyl alcohol	78-83-1	† 6,927	5,000	† 24,246,429	10,000,000
Isophorone	78-59-1	1,038	1,000	8,736,761	1,000,000
Kepone	143-50-0	NA	1	NA	10
Lead	7439-92-1	# 15	10	# 400,000	100,000
Lindane [gamma-BHC]	58-89-9	0.758	0.5	6,385	1,000
m-Cresol	108-39-4	† 1,154	1,000	† 4,041,071	1,000,000
m-Xylene	108-38-3	† 46,183	10,000	† 161,642,857	100,000,000
Maleic hydrazide	123-33-1	† 11,545	10,000	† 40,410,714	10,000,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Manganese	7439-96-5	† 3,232	1,000	† 11,315,000	10,000,000
Mercury	7439-97-6	# 2	1	NA	10
Methacrylonitrile	126-98-7	† 2.31	1	† 8,082	1,000
Methanol	67-56-1	† 11,545	10,000	† 40,410,714	10,000,000
Methomyl	16752-77-5	† 577	500	† 2,020,536	1,000,000
Methoxychlor	72-43-5	† 115	100	† 404,107	100,000
2-Methoxyethanol acetate	110-49-6	† 46.2	10	† 161,642	100,000
2-Methoxyethanol	109-86-4	† 23.1	10	† 80,821	10,000
3-Methylcholanthrene	56-49-5	# 219	100	# 367,000	100,000
4,4'-Methylene bis(2-chloroaniline)	101-14-4	7.58	5	† 56,575	10,000
Methyl ethyl ketone	78-93-3	† 13,855	10,000	† 48,492,857	10,000,000
Methyl isobutyl ketone	108-10-1	† 1,847	1,000	† 6,465,714	1,000,000
Methyl methacrylate	80-62-6	† 32,328	10,000	† 113,150,000	100,000,000
Methyl parathion	298-00-0	† 5.77	1	† 20,205	10,000
Methyl tert-butyl ether	1634-04-4	# 20	10	NA	100
Methylene bromide	74-95-3	† 230	100	† 808,214	100,000
Methylene chloride	75-09-2	131	100	1,106,656	1,000,000
Molybdenum	7439-98-7	† 115	100	† 404,107	100,000
n-Butyl alcohol	71-36-3	† 2,309	1,000	† 8,082,143	1,000,000
n-Dioctyl phthalate	117-84-0	† 461	100	† 1,616,429	1,000,000
n-Hexane	110-54-3	† 1,385	1,000	† 4,849,286	1,000,000
N-Nitrosodi-n-propylamine	621-64-7	0.14	0.1	1,185	1,000
N-Nitrosodi-n-butylamine	924-16-3	0.182	0.1	1,537	1,000
N-Nitrosodiphenylamine	86-30-6	201	100	1,693,861	1,000,000
N-Nitrosopiperidine	100-75-4	# 3,650	1,000	# 6,110,000	1,000,000
N-Nitrosopyrrolidine	930-55-2	0.469	0.1	3,952	1,000
Naphthalene	91-20-3	† 461	100	† 1,616,429	1,000,000
Nickel	7440-02-0	† 461	10	† 1,616,429	1,000,000
Nitrobenzene	98-95-3	† 11.5	1000	† 40,411	10,000
N,N-Dimethyl formamide	68-12-2	† 2,309	1,000	† 8,082,143	1,000,000
o-Cresol	95-48-7	† 1,154	1,000	† 4,041,071	1,000,000
o-Toluidine	95-53-4	4.1	1	34,583	10,000
Octamethylpyrophosphoramide	152-16-9	† 46.2	10	† 161,643	100,000
p-Cresol	106-44-5	† 115	100	† 404,107	100,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
p-Toluidine	106-49-0	5.19	1	43,683	10,000
Parathion	56-38-2	† 138	100	† 484,929	100,000
Pentachlorobenzene	608-93-5	† 18.5	10	† 64,657	10,000
Pentachlorodibenzo-*p*-dioxins **	36088-22-9	0.0000066	0.000005	0.06	0.005
Pentachlorodibenzofurans **	30402-15-4	0.000013	0.000005	0.11	0.005
Pentachloronitrobenzene	82-68-8	3.79	1	31,923	10,000
Pentachlorophenol	87-86-5	8.21	1	69,166	10,000
Perchlorate	14797-73-0	**#** 1,000	1,000	NA	10000
Phenol	108-95-2	† 13,855	10,000	† 48,492,857	10,000,000
1,3-Phenylenediamine	108-45-2	† 138	100	† 484,929	100,000
Phorate	298-02-2	† 4.62	1	† 16,164	10,000
Polychlorinated biphenyls [as Aroclors]	1336-36-3	2.46	1	4,149	1,000
p,p'-DDD	72-54-8	4.1	1	34,583	10,000
p,p'-DDE	72-55-9	2.9	1	24,411	10,000
p,p'-DDT	50-29-3	2.9	1	24,411	10,000
Pronamide	23950-58-5	† 1,731	1,000	† 6,061,607	1,000,000
Propylene oxide	75-56-9	4.1	1	34,583	10,000
Pyrene	129-00-0	† 692	100	† 2,424,643	1,000,000
Pyridine	110-86-1	† 23.1	10	† 80,821	10,000
Safrole	94-59-7	**#** 365	100	**#** 611,000	100,000
Selenium	7782-49-2	† 115	100	† 404,107	100,000
Silver	7440-22-4	† 115	100	† 404,107	100,000
Silvex	93-72-1	† 184	100	† 646,571	100,000
Strychnine	57-24-9	† 6.92	1	† 24,246	10,000
Styrene	100-42-5	† 4,618	1,000	† 16,164,286	10,000,000
Styrene oxide	96-09-3	**#** 3,650	1,000	**#** 6,110,000	1,000,000
Sulfide	18496-25-8	**#** 1,820	1,000	**#** 3,060,000	1,000,000
1,2,4,5-Tetrachlorobenzene	95-94-3	† 6.92	1	† 24,246	10,000
2,3,7,8-TCDD**	1746-01-6	0.0000066	0.000001	0.06	0.005
Tetrachlorodibenzo-*p*-dioxins**	41903-57-5	**#** 0.00001	0.000001	NA	0.005
Tetrachlorodibenzofurans**	55722-27-5	**#** 0.00001	0.000001	NA	0.005
1,1,1,2-Tetrachloroethane	630-20-6	37.9	10	319,228	100,000
1,1,2,2-Tetrachloroethane	79-34-5	4.93	1	41,499	10,000
Tetrachloroethylene	127-18-4	18.9	10	159,614	100,000

Table B4-1
SIS Constituents with Screening Factors within the Capabilities of Known Methods (continued)

Analyte	CAS No.	Water		Sediment and Sludge	
		Screening Factor (µg/L)[1]	Target QL (µg/L)	Screening Factor (µg/kg)[1]	Target QL (µg/kg)
Tetraethyldithiopyrophosphate	3689-24-5	† 11.5	10	† 40,411	10,000
2,3,4,6-Tetrachlorophenol	58-90-2	† 692	500	† 2,424,643	1,000,000
Thallium	7440-28-0	† 1.84	1	† 6,466	1,000
Thiram	137-26-8	† 115	100	† 404,107	100,000
Toluene	108-88-3	† 4,618	1,000	† 16,164,286	10,000,000
2,4-Toluenediamine	95-80-7	0.308	0.1	2,593	1,000
Toxaphene	8001-35-2	0.896	0.5	7,545	1,000
1,2,4-Trichlorobenzene	120-82-1	† 230	100	† 808,214	100,000
1,1,1-Trichloroethane	71-55-6	# 792	500	# 768,000	100,000
Trichloroethylene	79-01-6	89.6	50	754,538	100,000
Trichlorofluoromethane	75-69-4	† 6,927	5,000	† 24,246,429	10,000,000
2,4,5-Trichlorophenol	95-95-4	† 2,309	1,000	† 8,082,143	1,000,000
2,4,6-Trichlorophenol	88-06-2	89.6	50	754,538	100,000
2,4,5-Trichlorophenoxyacetic acid	93-76-5	† 230	100	† 808,214	100,000
1,2,3-Trichloropropane	96-18-4	0.14	0.1	1,185	1,000
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	† 692,755	100,000	†2,424,642,857	100,000,000
1,1,2-Trichloroethane	79-00-5	17.3	10	145,613	100,000
1,3,5-Trinitrobenzene	99-35-4	† 692	500	† 2,424,643	1,000,000
Tris(2,3-dibromopropyl) phosphate	126-72-7	# 0.13	0.1	# 1,100	1,000
Vanadium	7440-62-2	† 162	100	† 565,750	100,000
Vinyl acetate	108-05-4	† 23,091	10,000	† 80,821,429	10,000,000
Vinyl chloride	75-01-4	0.519	0.5	4,368	1,000
Warfarin	81-81-2	† 6.92	1	† 24,246	10,000
o-Xylene	95-47-6	† 46,183	10,000	† 161,642,857	100,000,000
p-Xylene	106-42-3	# 365	100	# 611,000	100,000
Xylenes, mixed isomers	1330-20-7	† 46,183	10,000	† 161,642,857	100,000,000
Zinc	7440-66-6	† 6,927	1,000	† 24,246,429	10,000,000

Notes to Table B4-1:

1 Values represent carcinogenic risk screening values unless noted otherwise.
† Noncarcinogenic risk screening factor.
# Value obtained from EPA Region 9 Preliminary Remediation Goals.
NA A cancer slope factor or non-cancer reference dose value were not available to calculate the screening factor and an associated concentration was not listed as a Region 9 Preliminary Remediation Goal.

* This compound will be reported under this CAS number, which EPA determined in 1976 and 1988 was the number that should be applied to the compound on the Priority Pollutant List. This compound sometimes has been reported under the CAS number 39638-32-9, but that number will not be used for the SIS project.

** The reporting units for the PCDDs/PCDFs will be picograms per liter (pg/L) for aqueous samples and nanograms per kilogram (ng/kg) for sediment and sludge samples.

Table B4-2
SIS Constituents With Screening Factor For Water That May Be Difficult to Achieve

		Water		Sediment and Sludge	
Analyte	**CAS No.**	**Screening Factor (µg/L)[1]**	**Target QL (µg/L)**	**Screening Factor (µg/kg)**	**Target QL (µg/kg)[1]**
Diethylstilbestrol	56-53-1	0.00021		1.77	1
Benzidine	92-87-5	0.0043		36.1	10
Bis(chloromethyl) ether	542-88-1	0.0045		37.7	10
1,3-Butadiene	106-99-0	**#** 0.006		**#** 4	1
2-Nitropropane	79-46-9	**#** 0.001		NA	1
N-Nitrosodiethylamine	55-18-5	0.0066		55.3	50
Ethylene dibromide	106-93-4	0.012		97.7	50
N-Nitrosodimethylamine	62-75-9	0.019		163	100
N-Nitroso-N-methylethylamine	10595-95-6	0.045		377	100
Triethylamine	121-44-8	**#** 12.2	10	**#** 23,400	*

Notes to Table B4-2:

1 Values represent carcinogenic risk screening values unless noted otherwise.
Value obtained from EPA Region 9 Preliminary Remediation Goals.
NA A cancer slope factor or non-cancer reference dose value were not available to calculate the screening factor and an associated concentration was not listed as a Region 9 Preliminary Remediation Goal.

* OSW recently validated a direct aqueous injection analysis technique for the analysis of this compound in aqueous samples, however EPA did not validate any techniques for solid samples. OSW suggested that this compound could be leached from solid samples with water and the leachate analyzed, however, such an approach has to be validated before it could be applied to the SIS project.

The constituents in Table B4-3 are divided into three groups. The first group includes those constituents for which analytical methods are not known for the environmental matrices in the SIS project. This group includes dyes such as Direct Black 38, Direct Brown 95,and Direct Blue 6, as well as constituents such as ammonium perchlorate and nickel subsulfide. For the

latter two constituents (and others in this group), methods exist for ionic species such as perchlorate, or ammonium, but not for the determination of the parent constituent in the presence of other sources of either ionic species.

Table B4-3
SIS Constituents Which May Be Non-Analyzable

Analyte	CAS No.	Water Screening Factor (µg/L)[1]	Sediment and Sludge Screening Factor (µg/kg)[1]
No method for the specific compound			
Ammonium perchlorate	7790-98-9	NA	NA
Ammonium vanadate	7803-55-6	**#** 10.9	**#** 18,300
Cyanogen bromide [Bromine cyanide]	506-68-3	† 2,078	† 7,273,929
Cyanogen chloride [Chlorine cyanide]	506-77-4	† 1,155	† 4,041,071
Direct Brown 95	16071-86-6	0.11	892
Direct Black 38	1937-37-7	0.11	965
Direct Blue 6	2602-46-2	0.12	1,025
Formic Acid	64-18-6	† 46,184	† 161,642,857
Nickel Subsulfide	12035-72-2	NA	NA
No standard available from any source			
Aramite	140-57-8	39.4	331,997
Compound cannot exist in water or wet solids			
Acrylic acid	79-10-7	† 11,546	† 40,410,714
Hydrazine	302-01-2	0.33	2,767
Maleic anhydride	108-31-6	† 2,309	† 8,082,143
Phthalic anhydride	85-44-9	† 46,183	† 161,642,857

Notes to Table B4-3:

1 Values represent carcinogenic risk screening values unless noted otherwise.
† Noncarcinogenic risk screening factor.
# Value obtained from EPA Region 9 Preliminary Remediation Goals.
NA A cancer slope factor or non-cancer reference dose value were not available to calculate the screening factor and an associated concentration was not listed as a Region 9 Preliminary Remediation Goal.

Second, aramite is included in this table because there are no known sources in the US for an authentic standard of this compound. As a result, it is not possible to calibrate any analytical method for this compound, and therefore, no reasonable means exists by which to either identify or quantitate this compound.

The last group of constituents in Table B4-3 cannot exist in the presence of water because they will decompose on contact with water. Therefore, we do not recommend analysis for these constituents in water samples or wet solids such as sediments or sludges from the SIS project.

B4.3 Facility-Specific Constituents of Concern

The constituents in Tables B4-1, B4-2, and B4-3 represent the universe of potential constituents of concern for the SIS project. A facility-specific list of constituents of concern will be developed for each site, based on information contained in the surveys completed by each facility, process knowledge, data from existing sources such as NPDES discharge data, and other sources.

NOTE: The facility-specific constituents of concern will be determined by EPA. A constituent will not be included in a facility-specific list unless there is reasonable potential to expect it to be present at the site. Therefore, the facility-specific constituents will comprise a small to very small subset of the total list of potential constituents.

Prior to developing each facility-specific SAP, SAIC will obtain the list of facility-specific constituents from EPA. SAIC will include that list in the SAP along with the target quantitation limits for those constituents. The laboratory performing the analyses of samples from each site will be provided with the facility-specific SAP and the list of constituents as early as possible in the process. The laboratory will be responsible for identifying appropriate sample preparation, cleanup, and analysis methods, including any changes to routine methods that may be required to complete the analysis of the facility-specific constituents. Examples of such information will include:

- The name and/or number of all of the methods and the method sources (e.g., SW-846 Method 5030, EPA Method 1613B, etc.) for each constituent or group of constituents.

- Any modifications to routine procedures employed in the laboratory that are known in advance to be necessary to meet the target quantitation limits or other performance objectives (e.g, the use a 25-mL purge volume for some volatiles in Method 5030, concentration of the sample extract below 10 mL for Method 8082, etc.).

SAIC will work with the laboratory during the development of each facility-specific SAP to identify the candidate analytical procedures and any changes to their routine use of the procedures that can be anticipated. SAIC will review the information provided by the laboratory, consult with EPA if necessary, and compile the information into a facility-specific statement of work (SOW) for the analysis of the samples.

The SAP and the associated facility-specific SOW will also provide the requirements for the type, frequency, and acceptance criteria for all the quality control checks that will be employed by the laboratory in conjunction with the sample analyses, as well as the anticipated calibration range for each constituent and the initial instrument operating conditions that will be employed. Section B5 contains a discussion of the types of QC checks. SAIC will provide each facility-specific SAP and SOW to EPA for review and approval before analyses are initiated by the laboratory.

B4.4 Analytical Performance

The laboratory shall document and report the performance of each analytical method used in its laboratory in conjunction with the samples being analyzed. The documentation will include raw data for all field samples and quality control samples described in the relevant methods and in the facility-specific SAP and SOW.

B4.5 Laboratory Corrective Action

Each laboratory performing analyses as part of this study will be required to review and validate its own results prior to reporting them to SAIC. Whenever a result falls outside of the facility-specific performance criteria described in the SAP and SOW, the laboratory will be responsible for investigating the causes and taking corrective actions.

The corrective actions may include, but are not limited to:

- Reanalysis of standards (e.g., for calibration or calibration verification)
- Adjustment of instrument operating conditions, followed by reanalysis of standards
- Reanalyses of all samples associated with out of control operations.

Ideally, the review of the results from instrument performance checks or other quality control checks will be conducted prior to beginning the analysis of samples. However, in instances where this is not possible or not practical (e.g., when sample analyses are conducted overnight on automated instrumentation), the laboratory will be responsible for reanalysis of all the associated samples following the corrective actions.

The goal of all such corrective actions will be to provide the best quality results to EPA. All laboratory corrective actions will be documented by the analyst and confirmed in writing by the appropriate level of laboratory management (e.g., two-party sign-off). All quality problems will be communicated to the SAIC laboratory coordinator by the laboratory management in a timely fashion. Such communications may occur by telephone, provided that they are followed up in writing (e.g., fax or e-mail). SAIC, in turn, will communicate with EPA regarding quality problems and corrective actions.

NOTE: Corrective actions will only be required in association with the facility-specific constituents of concern. If, as a matter of practicality, the laboratory includes other analytes or target analytes for other sites in calibration standards, matrix spiking solutions, or other quality control samples, the laboratory will not be required to either assess the performance for those other analytes, nor take corrective actions in response unless such actions are also required to address the facility-specific target analytes.

B5 Quality Control Requirements

This section specifies the measurement QC checks for both field and laboratory activities. This section also describes the data quality indicators that will be used to interpret the degree of acceptability or utility of the data. The facility-specific SAPs will specify additional requirements or identify deviations from this QAPP based on facility-specific analytical considerations.

B5.1 Field QC Procedures

Quality control checks to be employed during field activities will include calibration of any field monitoring equipment in accordance with manufacturer's specifications as well as collection, preparation, and analysis of the various QC samples discussed below:

1. Field duplicate: A field duplicate will be prepared at a frequency of one per day per matrix. A field duplicate is an independent sample which is collected as close as possible to the same point in time and space as the primary field sample. The duplicate is placed in a separate container from the first sample, shipped to the laboratory, and analyzed independently. Field duplicates are used to estimate the reproducibility (precision) of the sampling process. Field duplicates may be submitted to the laboratory blind (i.e, not identifiable as a field duplicate) or openly.

2. Equipment rinsate: An equipment rinsate blank will be collected from the sample collection devices used for both the wastewater sludge and the solid matrix sample residuals. The equipment blanks will be obtained either prior to or during sample collection activities. The analyses required for the equipment rinsate blanks will depend on the facility-specific target analyte list selected by EPA and will be specified in each facility-specific SAP. Analytical data generated from these analyses will be used to assess possible sample contamination from the sampling equipment.

3. Trip blank: Trip blanks will be prepared at a frequency of one per day of sampling during which samples will be collected for volatile organic constituents. Trip blanks will be prepared prior to the site visit at the time sampling kits are shipped to the site. The trip blank will accompany the sampling kits throughout all the sample collection and transport operations. This blank will not be opened during sampling activities and will be used to assess sample contamination originating from sample transport, shipping, or site conditions.

4. Temperature blank: A temperature blank will be included with each cooler of samples. Upon receipt, the laboratory will use this blank to determine the internal temperature of each cooler. The laboratory will record the temperature of each cooler and notify the SAIC laboratory coordinator as soon as possible if any coolers are received with internal temperatures above the range of $4 \pm 2^{\circ}C$.

B5.2 Laboratory QA/QC Procedures

The following laboratory internal analytical quality control measures, where appropriate, will be employed to ensure the quality of the analytical data. A QC frequency table will be included

with each facility-specific SAP that describes the QC measures associated with the field samples for that site.

- Spikes: For organic analyses, a matrix spike and matrix spike duplicate analysis (MS/MSD) will be prepared and analyzed for each analytical method and each sample matrix, at a frequency of at least 5% of the samples of the same matrix. For inorganic analyses, a matrix spike and an unspiked duplicate sample pair will be analyzed. SAIC sampling personnel will provide extra sample volume for those samples designated for spiking or duplicate analyses. Spiked duplicates will be analyzed for organics because there is a high probability that the target analytes will not be present in the sample. In such a case, analysis of unspiked duplicates would result in duplicate "non-detect" results, which does not allow for a meaningful assessment of precision. Analysis of spiked duplicate samples ensures a positive value, allowing for estimation of analytical precision. Because inorganic constituents are much more likely to be found in the samples, analysis of unspiked duplicate samples has a higher probability of yielding a usable estimation of precision.

  The samples will be spiked with all of the site-specific analytes of interest. Under ideal circumstances, the original, unspiked, field sample will be analyzed first, to determine an appropriate spiking concentration, which should be two to five times the concentration in the unspiked sample. However, if this approach is not practical, due to delivery schedules or other factors, the samples will be spiked at the midpoint of the instrumental calibration range. The laboratory will be responsible for generating precision and accuracy control limits for MS/MSD analyses, as described in the QC section of the analysis methods.

- Calibration blanks: A calibration blank is an aliquot of reagent water to which reagents have been added to match the matrix of the calibration standards. This blank is analyzed after the instrument calibration and after every ten samples. The calibration blank will not undergo any sample digestion or preparation procedures prior to analysis. This analysis result will help determine reagent purity and ensure baseline stability.

- Method blanks: A method blank will be prepared from an aliquot of a clean reference matrix (e.g., reagent water or clean sand) and carried through the complete sample preparation and analytical procedure. The method blank results are used to document contamination resulting from the analytical process. Method blanks will be prepared at a frequency of a minimum of one per batch of samples prepared together, or every twenty samples, whichever is greater.

- Surrogates: Surrogate compounds will be spiked into the samples designated for the various organic analyses (except PCDDs/PCDFs). Surrogates are organic compounds which are similar to the target analytes in chemical composition and behavior in the analytical process, but are not normally found in residual samples. The laboratory will be responsible for choosing appropriate surrogates, based on the site-specific target compounds, and developing surrogate recovery acceptance criteria.

- Calibration standards: Calibration standards will be prepared from commercial high-purity materials. The stability of the standards will be monitored, and new standards will be prepared whenever stability problems are encountered or holding times are exceeded. Calibration standards will be used to determine instrument range, detection or quantitation limits, precision, and instrument drift.

- Internal standards: Internal standards will be used, where feasible, to monitor the consistency of response factors, relative retention times, injection efficiency, instrument drift, etc., for many organic analyses. Internal standards are used primarily in the GC/MS methods, including volatile organics, semivolatile organics, and PCDDs/PCDFs. Procedures for employing internal standards are described in the analytical methods.

- QC check standards: For the inorganic analytes, a QC check standard will be analyzed with each calibration and following every ten samples or according to the procedures as detailed in each analytical method. The QC check standard recovery must be within ±10 percent of the true value or be within the limits set in the method.

- Laboratory water purity: Reagent water meeting the specifications for ASTM Type II water will be used for all analyses.

In addition to these QC measures, each laboratory will maintain and employ a quality assurance program that includes a current Quality Management Plan and method-specific Standard Operating Procedures (SOPs) for each procedure employed.

B5.3 Data Quality Indicators

Data quality indicators (DQIs) are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, bias, representativeness, comparability, and completeness. Each of these DQIs is described more fully in the subsections that follow. This section also establishes the acceptance criteria for the DQIs that set quantitative goals for the quality of data generated in the analytical measurement process. DQIs may be expressed for entire measurement systems, but it is customary to allow DQIs to be applied only to laboratory measurement processes.

Of the five principal DQIs, precision and bias are the quantitative measures, representativeness and comparability are qualitative measures, and completeness is a combination of both quantitative and qualitative measures.

B5.3.1 Precision

Precision is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions.

For the SIS sampling program, precision of the analyses will be evaluated in each sample matrix at a minimum frequency of 5 percent per batch (i.e., at least 1 in every 20 samples). Duplicate spiked samples (for organics) or duplicate unspiked samples (for metals and other inorganics) will be used to calculate a measure of precision between the two spiked sample concentrations, and expressed as Relative Percent Difference (RPD).

Precision will be calculated using the following equation for relative percent difference:

$$RPD = \frac{|C_1 - C_2|}{\frac{(C_1 + C_2)}{2}} \times 100$$

where:

RPD = relative percent difference,
C_1 = result for the first aliquot
C_2 = result for the second aliquot

Note that due to the use of the absolute value in the numerator, the RPD will always be a positive number.

The quality control limits for precision will be the acceptance criteria generated by the laboratory, as described in the QC section of the analytical methods. In the absence of laboratory-generated control limits, 50% will be used as the control limit for RPD.

B5.3.2 Bias

Bias is a measure of the closeness of agreement between an observed value and an accepted reference value. For the SIS project, bias will be defined in terms of the recovery of matrix spikes samples prepared in the laboratory for each matrix. As described above, for organics, a matrix spike and a matrix spike duplicate will be prepared and analyzed, at a minimum, on one sample from each type of waste or sample matrix. For metals and other inorganics, a single matrix spike sample may be employed to assess bias.

Each facility-specific SAP will specify which samples are to be used for the matrix spike and the matrix spike duplicate analyses along with the minimum spiking frequency. In the event that sufficient volumes of the samples specified in the SAP are not available at the time of sample collection, the SAIC field personnel will select another sample or samples for spiking and will provide additional sample material to the laboratory. The field personnel will note such deviations from the SAP and will notify EPA as soon as practical.

If samples are suspected to be highly contaminated (greater than 1 percent), a duplicate analysis may be substituted for the matrix spike duplicate analysis.

The percent recovery of the spiked analytes will be calculated using the following equation:

$$\%\ Recovery = \frac{C_s - C_u}{C_a} \times 100$$

where:

C_s = concentration of spiked aliquot,
C_u = concentration of unspiked aliquot,
C_a = concentration of spike added.

The quality control limits for matrix spike recovery will be generated by the laboratory, as described in the QC section of the analytical methods. Each laboratory will develop both warning limits and acceptance limits.

It is important to recognize that spike recovery is highly matrix-dependent and complex sample matrixes are likely to affect spiked analyte recoveries. In general, spike recoveries of 50% to 150% can be expected from some of the sample matrices anticipated for this sampling effort. In the event that spike recoveries obtained are either outside the laboratory established control limits or outside 50 - 150%, the laboratory will notify the SAIC Laboratory Coordinator in order to assess the impact on data quality. SAIC will work with the laboratory to investigate the likely cause of the problem and determine appropriate corrective actions that will provide data that meet the objectives of the SIS project. Samples may be respiked and reanalyzed to demonstrate performance. SAIC and the laboratory will work together to determine if the reanalysis of the associated samples is necessary (e.g., to determine whether other data, such as surrogate recoveries in the unspiked samples, suggest that the problems with the spiked sample results are systematic, or an isolated random occurrence).

The laboratory must identify what action will be taken when the warning limits are exceeded. Warning conditions may only require more frequent observations of instrument performance, while rejection conditions (those data points outside the acceptance limits) require shutting down an instrument or terminating a procedure and implementing corrective action.

Note: The matrix spike requirements in each facility-specific SAP will *only* apply to the target analytes for that site. If, as a matter of practicality, the laboratory spikes samples with other analytes or target analytes for other sites, the laboratory will not be required to either assess the bias (recovery) for those other analytes, nor take corrective actions in response unless such actions are also required to address the site-specific target analytes.

B5.3.3 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether physical samples are collected in such a manner that the resulting data appropriately reflect the media and phenomena measured or studied.

Representativeness is a qualitative parameter that is addressed through selection and design of appropriate sampling locations and procedures. Representativeness expresses the degree to which the sample (i.e., the total number of observations) (1) has the properties and chemical composition of the population from which it was collected and (2) has them in the same average proportions as are found in the population. The representativeness quality assurance objective will be satisfied by making certain the sampling locations for a sample collection event are selected to minimize error that could be introduced during sample collection, handling, subsampling, and preparation.

B5.3.4 Comparability

Comparability is a qualitative measure of data quality that can be applied within a single data set (e.g., a site or project) or across data sets from similar sites or projects. At a minimum, comparability involves the use of similar reporting units for similar matrices. It can also involve consideration of either the form of an analyte that is measured in the samples or the specific aspects of the analysis technique. For example, while there is certainly some relationship between the dissolved, particulate, and total metal concentrations in aqueous samples from a given site, it would not be appropriate to report the results for one fraction in a given sample and to report the results of another fraction in a second sample if the results for both samples are to be used for the same purpose. Likewise, one should not report some solid sample results in dry weight concentrations and others in wet weight concentrations.

Unless otherwise specified, all data must be calculated and reported in units consistent with similar environmental data (e.g., μg/L or mg/L for aqueous samples and μg/kg or mg/kg for solids). For dioxin/furan analyses, the units will be pg/L for liquids and ng/kg for solids. For the SIS project, all results for non-aqueous samples will be reported as wet weight (as received) concentrations. The laboratory will determine the percent solid content for each solid sample and report that value along with the results, so that the dry weight concentration may be determined by the data user if needed.

B5.3.5 Completeness

Completeness of sampling will be calculated as a percentage of valid samples obtained for each site visit relative to the total number of samples collected. A sample is considered to be valid if the sample meets the project-specific objectives for precision and bias. The QA objective for completeness of sampling for this project is defined as 90 percent. If the completeness falls below this criterion, documentation will be provided that explains why the objective was not met and to describe the impact on the project.

B5.3.6 Performance Evaluation Samples and Reference Materials

The analysis of performance evaluation (PE) samples and standard reference materials (SRM) can be used to provide information on the baseline performance of a laboratory. However, the availability of these types of samples is often quite limited, particularly for the wide array of analytes of interest to this study.

Moreover, the analyses of such materials adds significantly to the analytical costs, while providing relatively little additional information beyond that of the QC samples described earlier. Therefore, given the budgetary constraints for this project, SAIC does not anticipate the use of PE samples or SRMs for any of the analytical procedures.

B6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The preventive maintenance program consists of scheduled (preventive) and nonscheduled maintenance procedures. All maintenance performed and the results of check standards will be documented. Maintenance procedures and schedules for equipment used in this work assignment will be available to the appropriate staff. The requirements are provided below.

B6.1 Field Equipment

All field equipment will be tested, inspected, and maintained in accordance with manufacturer recommendations. Prior to a sampling project, the field equipment to be used will be inspected and calibrated to ensure that it is working properly. Spare parts will be available and will be taken on the sampling trip if appropriate. Following its use, equipment will be decontaminated using the appropriate cleaning procedures required for the project (see Section B2 for decontamination procedures).

B6.2 Laboratory Equipment

The laboratory will develop and follow a preventive maintenance schedule recommended by the manufacturer for each analytical instrument. The laboratory will maintain a stock of spare parts and supplies and/or have service agreements in place for all instruments. Instrument maintenance logbooks will be kept with each instrument and will be updated by the operator whenever maintenance procedures are performed.

B7 Instrument Calibration and Frequency

This section describes the general requirements for the calibration of instruments used in both the field and the laboratory. This general discussion is supported by the specific discussions given in the analytical methods themselves, as well as standard operating procedures (SOPs) that are maintained in each laboratory, and the site-specific requirements described in each facility-specific SAP for this project. Wherever the specific requirements of a specific SAP differ from this general discussion, the SAP requirements will take precedence.

B7.1 Calibration of Field Instrumentation

Field sample collection equipment will not require calibration. All samples will be collected directly into the sample containers or with routine sampling equipment that does not require calibration.

Portable water quality monitoring equipment (e.g., for measurement of temperature, pH, and conductivity) will be calibrated in the field in accordance with manufacturer specifications.

In the event that air monitoring equipment is required to assess the sampling conditions or to protect worker safety, such equipment will be calibrated according to the manufacturer's directions, and in accordance with the SAIC health and safety plan.

B7.2 Calibration of Laboratory Instrumentation

The majority of the analytical methods to be employed for this project involve two types of calibration. The first type is a multi-point initial calibration that is performed prior to the analyses of any samples. The number of points may vary by analytical technique and the calibration model chosen by the laboratory, but typically ranges from a low of three points to a high of seven points (for non-linear calibration models).

The facility-specific SAP will describe the minimum number of calibration standards to be employed. The concentration of the lowest of the initial calibration standards for each analyte will be at or below the concentration that corresponds to the risk-based concentration (e.g., human health screening factors) for that analyte in each matrix of interest. The laboratory will be required to calculate the concentration in the low-point standard that corresponds to the risk-based concentration in the aliquot of a "typical" sample to be analyzed in this project (e.g., translating the risk-based levels into lower calibration limits for each instrument using the typical weights and volumes of sample, extracts, digestates, etc.).

All results for the site-specific target analytes must be reported within the demonstrated calibration range of the particular instrument. The laboratory will be responsible for choosing the concentration of the standards that are above the low-point standard for each analyte, based on the working range of the instrument and the calibration model chosen for each analyte. In other words, the facility-specific SAP will provide the risk-based concentration and the minimum number of calibration points for analyte and each technique. Using a performance-based approach, the laboratory will be free to choose the calibration model and working range for each analyte and to increase the number of standards beyond the minimum

number specified in the SAP, as appropriate for the calibration model. When a site-specific target analyte exceeds whatever calibration range is selected by the laboratory, the laboratory will be required to dilute the sample, extract, or digest to bring the results for that analyte within the demonstrated calibration range of the instrument, or to recalibrate the instrument with an appropriately wider calibration range.

The second type is the verification of the initial calibration. This is typically a single-point calibration verification that is performed at the beginning of each day on which analyses are performed, and for some methods, at regularly scheduled intervals throughout the analyses of the samples (e.g., once for every 10 samples). The facility-specific SAP will specify the minimum frequency at which the calibration must be verified, by analytical technique. Those specifications will be based on the guidance provided in such SW-846 methods as 8000B for organics and 7000B for metals, etc.

The procedures for both the initial calibration and the calibration verification are described in detail in each of the analytical methods, and often supported by discussions in the SW-846 "base method" for the type of analysis (e.g., in Method 8000B for all chromatography methods). Each laboratory's SOP for a given analytical method will address instrument calibration, including the preparation of standards and assessment of the calibration results. These SOPs must be available for review upon request by the SAIC Work Assignment Manager, the EPA Work Assignment Manager, or their designees. As noted earlier, the facility-specific SAP will provide the site-specific target analytes, the target detection or quantitation limits and the risk-based concentration for each target analyte, the minimum number of calibration standards, and the acceptance criteria for initial calibration and calibration verification for each analyte.

Calibration standards may be prepared using pure standard materials or purchased as certified solutions, and will include all of the target analytes for this project that are to be analyzed by a given method. The name of the manufacturer and the information regarding purity of the standard or the concentration of the stock solution, if commercially prepared, must be available upon request. Acceptance criteria for the standard themselves will be based on the data provided by the manufacturer, in the case of commercial standards, or based on data developed by the laboratory, in the case of standards prepared in the laboratory.

The results of all instrument calibrations will be recorded by the laboratory and will be available for inspection. This includes both initial calibrations associated with samples for this project, as well as the calibration verifications performed during the project. Copies of all calibration results associated with the samples will be provided by the laboratory in their report of analytical results.

All instrument calibration results will be evaluated by the laboratory against the calibration requirements in the facility-specific SAP before data are reported to SAIC. The laboratory will take corrective action in response to any calibration problems, as described in the relevant analytical methods and their own SOPs. Such corrective actions may include, but are not limited to, adjustment and recalibration of instrument followed by reanalyses of all affected samples. In other instances, the methods may permit results to be reported without reanalyses, e.g., when a calibration verification result is higher than allowed but the analyte

was not detected in the sample. In each such instance, however, the review of the calibration results will be documented and decisions to report the data "as is" will be noted in the narrative portion of the laboratory's data report.

Note: The calibration requirements in each facility-specific SAP will *only* apply to the target analytes for that site. If, as a matter of practicality, the laboratory analyzes standards containing other analytes or target analytes for other sites, the laboratory will not be required to either assess the quality of the calibrations for those other analytes, nor take corrective actions in response unless such actions are also required to address the site-specific target analytes.

If reanalyses are not possible due to conditions such as limited sample volume or holding time considerations, then the laboratory will notify the SAIC laboratory coordinator immediately. SAIC, in consultation with EPA and the laboratory, will determine the appropriate actions to be taken in those instances.

B7.3 Calibration of Laboratory Equipment

Laboratories also employ equipment during sample preparation that requires periodic calibration. The most obvious examples are balances used to weigh samples and reagents, and the thermometers used to check the temperatures of the samples upon receipt and during storage in the laboratory. Each laboratory will have an SOP for the calibration of such equipment that will include the following information, at a minimum:

Analytical Balance:	Prior calibration check with class "S" weights in the gram and milligram range. Other checks as appropriate in expected weighing range.
Thermometer:	Check against NBS thermometer every 6 months.

The laboratory will retain records of all such calibrations, but they are not a deliverable for this project.

B8 Inspection/Acceptance for Supplies and Consumables

This section establishes and documents a system for inspecting and accepting all sampling supplies and consumables that may directly or indirectly affect the quality of data generated from the Surface Impoundment Study (SIS) field sampling and analysis program. The quality of the supplies and consumables used in the field and by the laboratory can impact the quality of data generated by the study. Documented inspection and acceptance criteria will ensure the consistency of sampling equipment and associated supplies and thus help to minimize variability they may be introduced into the sampling and analysis processes. This section also documents the quantity of supplies that will be needed. This information on specific types and quantities of equipment and supplies required for each sampling visit will be provided in the facility-specific SAPs.

B8.1 Field Supplies and Consumables

This section describes the supplies needed by the field sampling team at each site at which sampling will be conducted. The choice of field supplies and consumables will, in part, be dictated by the medium to be sampled (e.g., water or sludge), the location or point of sample collection (e.g., outfall or impoundment), the chemical constituents of interest, and other practical and safety concerns. Table B8-1 lists the major items of equipment and supplies needed at each site to be sampled for the SIS field sampling and analysis program.

Table B8-1. Sampling Equipment and Supplies (Per Site)

Type of Equipment	***Specific Piece of Equipment or Expendable Item***	***Quantity***
Cleaning Supplies	Alconox®	As necessary
	Aluminum foil	2 boxes (75 sq. yds. each)
	Bottle, 250-mL for preparing 5% Nitric acid	1
	Buckets, 2-gallon plastic	2
	Hexane, pesticide grade (ship in DOT-E 9168 box)	1 L
	Methanol, pesticide grade (ship in DOT-E 9168 box)	1 L
	Nitric acid, concentrated ampules	As necessary
	Paper towels	2 rolls
	Scrub brushes, plastic	2
	Tubs, 2-gallon plastic	2
	Wash/squirt bottles, 500-mL	4
	Water, ASTM Type II reagent grade or equivalent	As necessary

Table B8-1. Sampling Equipment and Supplies (Per Site)

Type of Equipment	*Specific Piece of Equipment or Expendable Item*	*Quantity*
Sampling Equipment	Auger with extension handles	As necessary
	Scoop (stainless steel and polyethylene)	As needed
	Bucket, stainless steel	As necessary
	Ground-water sampling device (e.g. pump, bailer)	As necessary
	Single-use camera	1
	Containers, pre-cleaned (including splits) 40-mL vial with septum 60-mL temperature blank jars 125-mL wide-mouth amber jar with PTFE-lined cap 500-mL wide-mouth amber jar with PTFE-lined cap 1-L wide-mouth amber jar with PTFE-lined cap	To be specified in facility-specific SAP based on analyses to be conducted
	Dipper, bacon bomb, or liquid grab sampler	1
	Field logbook, all-weather bound	1
	Funnel, stainless steel	2
	Nitric acid ampules for preservation of blanks for total metals analysis	As necessary
	Sample labels	As necessary
	Pan, stainless steel	As necessary
	pH paper	1 box wide range
	Pipets, disposable	As necessary
	Poly sheeting, roll	As necessary
Personal Protective Equipment	Boots, steel-toed (pair)	1 per person
	Chemical-resistant safety goggles or splash shields	1 per person
	Coveralls, Tyvek®	1 per person, as specified in facility-specific H&S Plan
	First aid kit and manual	1
	Full-face respirators	1 per person
	Gloves, disposable Nitrile inner (XL)	1 or more per person
	Gloves, Neoprene or nitrile outer	1 or more per person
	Hard hats	1 per person
	Rain gear	1 per person
	Water, bottled, for consumption	2 6-packs

Table B8-1. Sampling Equipment and Supplies (Per Site)		
Type of Equipment	***Specific Piece of Equipment or Expendable Item***	***Quantity***
Sample Transport Supplies	"Fragile" or "Handle with Care" stickers	As necessary
	Bubble wrap (perforated)	As necessary
	Chain-of-custody forms	As necessary
	Coolers	As necessary
	Custody seals	As necessary
	Fedex regular forms	As necessary
	Fedex Dangerous Goods airbills	As necessary
	Ice	As necessary
	Markers, indelible and pens	4
	Pocket or utility knife	1
	Scissors	2 pair
	Shipping labels	As necessary
	Tape, bottle sealing	2 rolls
	Tape, clear wide	3 rolls
	Tape, strapping	3 rolls
	Trash bags, large	2 boxes
	Vermiculite/packing material	As necessary

B8.2 Inspection and Acceptance of Sampling Supplies and Consumables

Selection of major pieces of sampling equipment will be based on the item's specifications, known or expected performance, and recommendations for use as indicated in SW-846 and other guidance (e.g., ASTM) relevant to this effort. Newly received field equipment will be inspected by the Field Team Leader and his/her designee to ensure all parts are present and undamaged. If damage has occurred in shipping, the shipping agent will be notified. Once inspected and accepted, the equipment and supplies will be shipped to the sampling locations and reinspected for critical damage upon receipt and before use.

B8.3 Inspection and Acceptance of Laboratory Supplies and Consumables

The laboratory will provide and be responsible for inspecting all laboratory supplies and consumables (e.g., reagents, preservatives, standards). The laboratory will ensure that the supplies and consumables meet all applicable standards for use. The laboratory will provide sampling containers with the appropriate preservatives, if necessary, and be responsible for the inspection and acceptance of such containers and preservatives.

B9 Data Acquisition Requirements (Nondirect Measurements)

This section identifies the indirectly acquired data needed for implementation of this project. These data include information not directly acquired by the field sampling and analysis efforts covered by this QAPP.

B9.1 Acquisition of Nondirect Measurement Data

In addition to data obtained from field sampling and analysis conducted at selected facilities, other data needed for this project will come from survey responses submitted by selected facilities.

Data obtained from field sampling and analysis conducted at selected facilities will be used to supplement and verify facility-submitted data. The facility-submitted data will be obtained by EPA from responses to the *Survey of Surface Impoundments*. Each facility will submit information on its ownership, wastewater treatment system, environmental setting, and surface impoundment design and operation. In addition, facility-submitted data will include water quality data and chemical constituent concentrations

B9.2 Acceptance Criteria and Limitations of Nondirect Measurement Data

The use of EPA generated data to verify facility-supplied data will be highly dependent upon the form, quantity, and quality of the facility-submitted data. The EPA SIS Team will make determinations regarding the acceptability of nondirect measurement data for use in the overall study. Unacceptable or insufficient data from a facility or industry sector may indicate the need for EPA to conduct a sampling visit at a particular facility or a facility representing that industry sector.

B10 Data Management

This section describes the project data management scheme, tracing the path of the data from generation in the field or laboratory to final use or storage.

B10.1 Data Recording

The SAIC field team will record field data and observations and ensure accuracy of records in accordance with the procedures specified in Section A9, "Documentation and Records." All field measurements and observations will be recorded directly and legibly into project logbooks, with all entries signed and dated. If entries must be changed, the correction must not obscure the original entry. The reason for the change to an entry must be stated, and the corrected entry signed and dated by the person making the change.

The laboratory will create, maintain, and ensure accuracy of laboratory records in accordance with their respective standard operating procedures. All laboratory data will be cross-referenced to the appropriate trip blank, field blank, equipment blank, method blank, field replicate, matrix spike, and matrix spike duplicate. All dates pertinent to the project (e.g., dates that each sample is collected, shipped, received by the laboratory, prepared, and analyzed) will be referenced against the appropriate analytical holding times.

B10.2 Data Validation

Analytical data will be validated by assessing compliance of the QC data, which accompanies the analytical report, with the established project objectives. Specific data validation and usability assessment techniques are described in Sections D1 through D3.

B10.3 Data Transformation

Data transformation is the conversion of individual data point values into related values or possibly symbols using conversion formulas (e.g., units conversion or logarithmic conversion) or a system for replacement. The transformations can be reversible (e.g., as in the conversion of data points using a formula) or irreversible (e.g., when a symbol replaces actual values and the value is lost). No data transformations are planned for the SIS sampling and analysis program.

B10.4 Data Transmittal

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. For this project, routine data transmittal will include activities such as copying raw data from a notebook onto a data entry form for keying into a computer file and transmittal of hard copy data reports to SAIC from the laboratory. The scope of work for this project does not include electronic transfer of analytical data over a telephone or computer network.

B10.5 Data Reduction

The scheme for reduction of raw data, including all equations used to calculate concentration and reporting units, will be documented and reported. The raw data, standards, calibration data, data manipulations, and assumptions must be clearly marked, allowing verification and validation by external review. It is the responsibility of the laboratory, beginning with the analyst through the laboratory QC personnel, to assure accurate and compliant data prior to release. Each laboratory should have and use a data validation check list to ensure that all analytical QC requirements are met.

B10.6 Data Analysis

The sample analysis data generated from the field sampling program will be used in combination with other data (e.g., publicly available data, extrapolated data, assumptions, survey data, etc.) to determine, with an acceptable degree of certainty, what risks to human health and the environment are posed by constituents present in industrial wastewaters managed in nonhazardous waste surface impoundments. The sample analysis results alone will not be used to estimate a "statistical parameter of interest" (such as the mean or a percentile), rather, the data obtained from field sampling will be used to *supplement* survey data because it is impractical for EPA to use field samples as a primary source of data. Summary statistics will not be generated other than routine checks performed for QA/QC purposes.

There are no concentration-based action levels defined for decision-making, rather, the risk assessment process will generate estimates of risk.

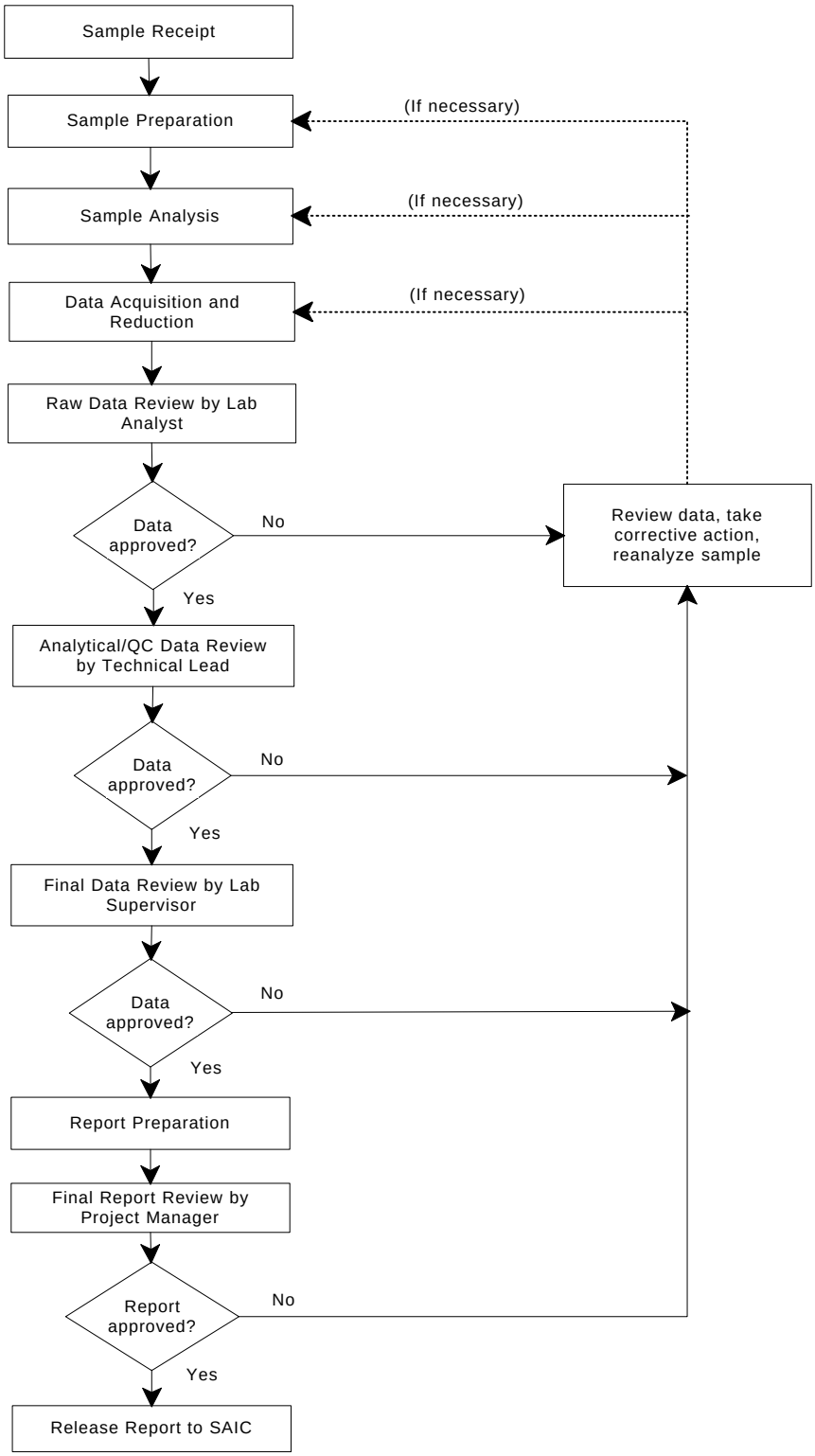
B10.7 Data Tracking and Reporting

Data management includes tracking the status of data as they are collected, transmitted, and processed.

Reports will be prepared by qualified staff only from properly reviewed and validated data. All data will be reported in units consistent with other measurements. Deviations from approved procedures, assumptions, data uncertainties, and QA/QC results, as well as external performance data, will be documented and reported. Assumptions will be clearly explained as to validity and limitations. The laboratory will also document any known or suspected sample matrix interferences present that may have inhibited the attainment of the desired method quantitation limits.

A flow chart depicting the overall data tracking and reporting scheme by the laboratory to SAIC is provided in Figure B10-1. Once received by SAIC, the laboratory analytical data report will be fully evaluated. Sections D1 and D2 summarize the validation procedures. Section B5 summarizes the criteria that will be evaluated. The results of this data validation effort will be documented in the waste characterization report for each facility.

Figure B10-1. Data Reduction, Validation, and Reporting Scheme



B10.8 Data Storage and Retrieval

Field data, logbooks, and other records will be maintained by SAIC in accordance with contract requirements.

The subcontractor laboratories will store data in accordance with subcontract requirements and laboratory standard operating procedures.

C1 Assessment and Response Actions

This section describes three types of assessments that may be applied to the work on this study:

- Field audits
- Laboratory audits, and
- Systems audits

Based on the scope of the current work assignment, SAIC does not anticipate that any of these audits will be conducted by SAIC. However, if EPA should amend the work assignment scope to include such audits, SAIC will conduct the assessments and report the results to EPA, along with a discussion of the response actions. The types of audits that may be requested and the related procedures are summarized below. (Note: As explained below, the laboratory is expected to conduct some form of internal audits under the auspices of its existing quality assurance program.)

C1.1 Field Audits

Field audits include the review of field documentation for legibility and completeness. The chain-of-custody procedures and documentation used in the field will be reviewed. The results of the analyses of field blanks and trip blanks will be reviewed as indicators of field performance. Each of these analyses is an indirect audit of measurements taken in the field to ensure sample integrity. The results of the analyses of field replicate samples will be reviewed as an indirect audit of the reproducibility of the sampling techniques as implemented by the field team.

Field audits may be conducted under the guidance outlined in SAIC's *Environmental Compliance & Health and Safety Program*, 1991. The results, along with documented problems and corrective action requests, will be submitted to the Field Team Leader, the WAMs, both EPA and SAIC, the Project Manager, and the SAIC QA Officer. The results of corrective actions will be verified by the SAIC WAM and sent to the EPA WAM. Unresolved corrective action requests will be submitted to corporate management for resolution.

C1.2 Laboratory Audits

Three types of laboratory audits are envisioned. The laboratory is expected to conduct some form of internal audits under the auspices of its existing quality assurance program. Records of such audits should be available to SAIC and EPA as a routine matter. The laboratory will report any adverse findings of audits that may occur during this project to SAIC, along with a detailed description of the corrective actions taken. SAIC, in conjunction with EPA, will evaluate the impact of those findings on this project and take appropriate corrective actions.

In addition, if the work assignment scope is appropriately amended, SAIC may conduct an audit of the laboratory to include the review of the procedures and documentation developed by the laboratory for this project and for all methods employed for this project. Laboratory audits may be conducted by the SAIC Quality Assurance Office and/or his designees.

Laboratory audits may be announced on unannounced, and EPA personnel may be invited to attend, depending on the nature of the audit and the reason for conducting it.

A laboratory audit will include a review of the following:

- Instrumentation logs
- Refrigerator and freezer temperature records
- Distilled/de-ionized water supply records
- Sample tracking system
- Standard tracking system
- Reagent chemical log-in, tracking, and disposal
- Computer data entry and collection.

During an audit, laboratory records and procedures will be inspected for completeness, accuracy, and adherence to the prescribed methods and any site-specific specifications described in the relevant sampling and analysis plans for this project. This inspection will include the following activities:

- Reviewing the laboratory SOPs and project-specific modifications for all analytical procedures associated with the project

- Following the sample C-O-C from time of sample receipt through all analysis steps to data reduction and validation and report generation

- Examining maintenance and calibration logbooks to ensure that maintenance and calibration are performed on a scheduled basis

- Examining procedures and records for data calculation transfer and validation

- Spot-checking calibration, QC, and sample data from selected instruments for selected days to ensure precision, accuracy, and completeness

- Inspecting storage arrays, glassware preparation areas, and distilled/de-ionized water system records and procedures

- Examining QA procedures and records (standard and spike solution logbooks and storage areas, control charts, and QA manuals).

The results of the audit will be discussed with the laboratory management and SAIC will work with the laboratory, as needed, to develop appropriate corrective actions. The laboratory and SAIC will maintain close communications regarding the findings and will track the corrective actions throughout the remainder of the project. The results of the audit and the corrective actions will be reported to EPA in a timely fashion.

The third type of audit that may be associated with this project is an audit conducted by a third party, including a state regulatory agency. SAIC will *not* employ information on third-party laboratory audits or certifications as a criterion in selecting a laboratory. The audits are not project-specific and may not even address the particular analyses conducted by the laboratory

for this project. However, such audits may provide limited information on the general capabilities of the laboratory. SAIC will obtain information from any laboratory participating in the project regarding any and all third-party audits and certifications (e.g., a list of dates and organizations). These records will be retained by SAIC and will be available to EPA on request.

C1.3 System Audits

The system audit consists of evaluation of all components of the sampling and measurement systems to determine their proper selection and use. This audit includes a careful evaluation of both field and laboratory quality control procedures. If requested and funded by EPA, system audits of site activities will be accomplished by an inspection of site activities by the SAIC QA Officer. This audit will consist of comparison, by the audit team, of current field practices with standard procedures. The following is a listing of the criteria to be used in the evaluation of field activities:

- Overall level of organization and professionalism
- Compliance of all activities with the work plan
- Compliance of all procedures and analyses with procedures outlined in the SAP
- Sample collection techniques versus SAP specifications
- Level of activity and sample documentation
- Working order of instruments and equipment
- Level of QA conducted by each field team
- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding
- Decontamination procedures
- Level of efficiency with which each team conducts planned activities at one site and proceeds to the next
- Sample packaging and shipment.

After the audit, any deficiencies will be discussed with the field staff and corrections will be identified. If any of these deficiencies might affect the integrity of the samples being collected, the SAIC QA Officer will inform the field staff immediately, so that corrections might be made.

C1.4 Response Actions

Corrective actions may also be initiated as a result of other QA activities, including performance audits, systems audits, and data audits. Guidelines for detection and investigation of problems, assessment of problems and actions taken, and resolution of problems are provided below. Problems that affect the quality of data, or relate to noncompliance with program or project requirements, must be reported to the appropriate level of management for resolution.

Problems may be detected by the laboratory staff, the laboratory coordinator, field team participants, the Field Team Leader, the Work Assignment Manager, the Project Manager, the SAIC QA Manager, or EPA. Problems can be generally classified as:

- Technical, such as data errors, data outliers, data or sample loss, and contamination
- Noncompliance with regulations, requirements, and approved procedures, among other standards
- Recurring problems, which by definition require resolution from sources outside of the Work Assignment Manager and Field Team Leader.

Program staff and supervisors must monitor their work accordingly. Staff and supervisors who detect or suspect problems must immediately notify the Work Assignment Manager and the QA Manager.

C2 Reports to Management

This section describes the frequency and distribution of reports issued to inform management of the status of the project; results of performance evaluations and system audits; results of periodic data quality assessments; and significant quality assurance problems and recommended solutions.

C2.1 Frequency, Content, and Distribution of Reports

The findings of all audits conducted, as requested and funded by EPA, under the guidance of this QAPP will be documented and delivered to the EPA WAM. The audit reports will contain, at a minimum, the date of the audit, a summary of the procedures used to perform the audit, a discussion of the audit findings, the signatures of the audit personnel, and the scope of corrective actions, if any are necessary.

The results of inspections, audits, summaries of problems, and corrective action requests will be reported to the EPA WAM as they are available.

C2.2 Personnel Responsible for Report Preparation

The SAIC Project Manager, in conjunction with the SAIC QA Manager, will identify critical areas of the project that may be subject to inspection. System audits and other inspections may be performed by the SAIC Quality Assurance Manager and reported to the appropriate SAIC staff. After review by the appropriate SAIC personnel, the reports will be given to the EPA WAM.

D1 Data Review, Validation, and Verification Requirements

The sections to follow summarize the validation and verification activities of this effort.

D1.1 Sampling Design

Section B1 describes the sampling design used in this project. The validation and verification process will include a review of field activity documentation to verify if the number and type of samples required in the facility-specific SAPs were, in fact, obtained and collected from the correct locations.

Each sample that was collected will be evaluated to determine conformity to the specifications described in the sampling design. The strength of the conclusions drawn from the data has a direct connection to the sampling design and deviations from that design. Any deviations will be noted in detail to allow subsequent data users to assess the usability of the data under different scenarios.

D1.2 Sample Collection Procedures

The sample collection procedures, including sampling equipment, employed in this study are described in detail in Section B2. Acceptable departures from the QAPP and the action to be taken if requirements cannot be satisfied will be specified in the facility-specific SAPs. Any deviations from the sample collection requirements will be noted in detail to allow subsequent data users to assess the overall impact and the data usability.

D1.3 Sample Handling

The sample handling and custody requirements described in Section B3 provide details on how the samples are physically manipulated and transported from the originating site to the analytical laboratory. In order to allow the appropriate interpretation of the measurement results, any deviations from the requirements specified in Section B3 and the facility-specific SAPs, and any actions taken to minimize or control the changes, will be noted in detail. In addition, events that occur during the sample handling phase that may affect the sample integrity will also be noted.

At a minimum, the personnel responsible for validation activities will evaluate the sample containers and the preservation methods used and determine if they are appropriate to the nature of the sample and type of data generated from the sample. Checks on the identity of the sample (e.g., proper labeling, complete C-O-C records, and correct sample identification by the receiving laboratory) as well as sample transport, laboratory receipt, and storage conditions will be made to ensure that the sample was representative of its native environment as it moved through the analytical process. Any deviations from the sample handling and custody requirements will be noted in detail along with a discussion of the potential effect of these deviations on data usability.

D1.4 Analytical Procedures

The analytical procedures used to generate the data will be evaluated to ensure that they were implemented as specified in Section B4 and the facility-specific SAPs. This will include verification that the laboratory performed the methods as described in the facility-specific SAP and that the project-specific performance was attained. Any deviations in the procedures will be noted in detail along with a discussion of the potential effects on data usability. Data qualifiers will be applied to the reported analytical data if there are deviations from the method requirements that may effect the data validity and usability.

D1.5 Quality Control

Section B5 of this QAPP specifies the QC checks that will be performed during sample collection, handling, and analysis. Each QC requirement identified in Section B5 and the facility-specific SAPs will be evaluated to determine if the QC check was performed at the correct frequency and if it met the specified acceptance criteria. Any deviations from the specified procedures and any corrective action taken will be noted in detail. In addition, a discussion of the potential effects of any deviations on the validity of the data will be included. Data qualifiers will be applied to the reported analytical data if the QC acceptance criteria were exceeded, and corrective action could not bring the affected results into compliance with the QC acceptance criteria.

D1.6 Calibration

Section B7 of this QAPP describes the process for calibration of field and laboratory equipment. The laboratory analytical report will be examined to ensure that, for each analytical method, the appropriate calibration was performed within an acceptable time prior to generation of the measurement data, and in proper sequence using an acceptable number of calibration standards that bracket the range of the reported analytical results. Any deviations in calibration procedures from the specified requirements of the QAPP and the facility-specific SAPs will be noted in detail along with a discussion of the potential effect on data usability.

D1.7 Data Reduction and Processing

All laboratory data will be cross-referenced to the appropriate trip blank, field blank, equipment blank, method blank, field duplicate, matrix spike, and matrix spike duplicate. All dates pertinent to the project (e.g., dates that each sample is collected, shipped, received by the laboratory, prepared, and analyzed) will be referenced against the appropriate analytical holding times. All laboratory raw data will be reviewed to ensure that calculations of reported sample results, QC sample results, and QA/QC results were performed and reported correctly. Any errors in calculation or transcription that are discovered will be reported to the SAIC Laboratory Coordinator, who will be responsible for requesting revised and corrected data. The laboratory will be required to submit revised data results pages, or if necessary, the entire data package, which will be clearly identified as a revision.

For each sampling location, an analytical data report will be prepared that contains the results of data validation and verification procedures. The report will include a description of any

problems discovered (such as sample holding time violations, blank contamination, or poor matrix spike recoveries) and a description of any data qualifiers that were applied to the reported data as a result of the data verification and validation effort.

D2 Validation and Verification Methods

This section summarizes the methods to be used during data validation and verification.

D2.1 Data Validation and Verification Process

Data validation and verification procedures are performed to ensure that the sampling and analysis protocols specified in the QAPP and the facility-specific SAPs were followed, and that the measurement systems were performed in accordance with the specified criteria. Analytical data will be validated by assessing compliance of the QC data, which accompanies the analytical report, with the established project objectives. If any QC data exceed the acceptance criteria, the analyses must be stopped until the problem is identified and resolved. After the problem is resolved, all analyses since the last in-control check may be repeated or discarded, depending on the specific nature of the problem. All criteria used to validate data integrity during collection and reporting of data will be documented and reported. All original and final data will be reviewed and/or validated by technically qualified staff, and these actions documented in the program records. The documentation will include the date the work was performed, the name of the reviewer, and the items reviewed or validated. Reviews may include the following:

- Inspecting documentation/records management practices
- Inspecting qualifications of staff
- Inspecting calibration and maintenance of equipment
- Examining QC data and QC checks
- Inspecting for adherence to approved procedures.

Validation may include the following:

- Verification of all data transfers, including electronic transfers.

- Verification of formulae and computer programs.

- Verification of data manipulations. Calculations must be supported by sufficient data and explanation to permit cross-checking, and investigative procedures must be clearly presented.

- Identification and treatment of outliers. The methods used may include statistical techniques, such as the use of outlier tests or control charts.

D2.2 Data Reporting

Laboratory analytical reports will be prepared by qualified staff only from properly reviewed and validated data. All data will be reported in the units specified in the facility-specific SAP. Deviations from approved procedures, assumptions, data uncertainties, and QC results, as well as external performance data, will be documented and reported. Assumptions will be clearly explained as to validity and limitations. The laboratory will also document any known or

suspected sample matrix interferences and any corrective actions taken in response to such interferences.

A flow chart depicting the overall data handling and reporting scheme by the laboratory to SAIC is provided in Section B10.

Once received by SAIC, the laboratory analytical data report will be fully evaluated based on EPA Tier IV validation procedures, using the project objectives and acceptance criteria. At a minimum the following QC criteria will be evaluated:

- Sample collection
- Holding times (where applicable)
- Field and laboratory blanks
- Laboratory duplicates
- Matrix spike recoveries
- Laboratory control sample recoveries
- Initial and continuing calibration
- Internal standard recoveries.

The following criteria pertain to PCDD/PCDF only:

- Identification of target analytes (RRT, ion abundance ratios, and S/N requirements)
- Second column confirmation of 2,3,7,8-TCDF.

The results of this independent data validation effort will be documented in a sampling and analytical data report that will be provided to the EPA WAM for review and comment.

D3 Reconciliation with Data Quality Objectives

This section describes how the results obtained from the project or task will be reconciled with the requirements defined by the EPA SIS Team.

D3.1 Reconciliation with Method-Specific Acceptance or Performance Criteria

As part of the data verification and validation process, SAIC will reconcile the data with the method-specific performance criteria and the data quality indicators of precision, bias, reproducibility, comparability, and completeness. Data verification and validation will be performed as described in Sections D1.0 and D2.0 of this QAPP. The results will be used in interpreting the degree of acceptability or utility of the data. The output of this process will be documented in data validation reports (also called the waste characterization reports) prepared for each set of analytical data generated from each facility sampling visit (see also Section A9 "Documentation and Records").

D3.2 Reconciliation With Project Objectives

In the DQO process, the EPA SIS Team identified the following intended uses of the data:

- Verify facility submitted data
- Fill gaps in existing data
- Validate outputs of models
- Use as inputs in the risk analyses.

Because the data will not be used to estimate a parameter of interest (such as mean concentration levels) or to test a statistical hypothesis, it will not be necessary to conduct formal statistical analyses and draw conclusions based on such analyses.

To the extent possible, the monitoring data will be evaluated to respond to two of the study purposes as discussed below:

Verification of facility-submitted data: The ability to use the EPA-generated data to verify facility-supplied data will be highly dependent upon the form, quantity, and quality of the facility-submitted data. Assessment of the data will be made by using expert opinion to ensure that the values being checked are not wildly improbable, or that they are within the range or limit that is considered reasonable.

Validation of model outputs: One objective is to use actual site monitoring data to determine whether the multimedia models provide accurate output (i.e., to compare actual field data to calculated (modeled) risks). It is anticipated that both facility-supplied data as well as the EPA-generated data could be used for this purpose. Additional information on model validation will be available in the *Surface Impoundment Study Technical Plan for Human Health and Ecological Risk Assessment* (USEPA 2000), and after EPA has specified which models need validation.

D3.3 Final Reports

SAIC will prepare waste characterization reports (to include data validation results) for each facility and a final report summarizing the sampling and analysis data for all facilities visited. The waste characterization reports (e.g., data validation reports) will discuss limitations on the use of any data for purposes of the study. The summary final report will summarize the sampling activities conducted at each facility and show a comparison between the data obtained from the sampling and analysis conducted under this study to those data provided by facilities in the survey. The report will indicate whether the facility-submitted data are in reasonable agreement with the industry data. Any issues of interest, found as a result of analytical data review and comparison with the survey data, will also be mentioned.

References

ASTM D 5013-89. 1989. *Standard Practices for Sampling Wastes from Pipes and Other Point Discharges*. West Conshohocken, PA.

ASTM D 5088-90. 1990. *Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites*. West Conshohocken, PA.

ASTM D 5358-93. 1993. *Standard Practice for Sampling with a Dipper or Pond Sampler*. West Conshohocken, PA.

ASTM D 5633-94. 1994. *Standard Practice for Sampling with a Scoop*. West Conshohocken, PA.

ASTM D 5743-97. 1997. *Standard Practice for Sampling Single or Multilayered Liquids, With or Without Solids, in Drums or Similar Containers*. West Conshohocken, PA.

ASTM D4547-98. 1998. *Standard Guide for Sampling Waste and Soils for Volatile Organic Compounds.* West Conshohocken, PA.

ASTM D 6323-98. 1998. *Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities*. West Conshohocken, PA.

Gy, P. 1998. *Sampling for Analytical Purposes*. Chichester, England: John Wiley & Sons, Inc.

Pitard, F.F. 1993. *Pierre Gy's Sampling Theory and Sampling Practice: Heterogeneity, Sampling Correctness, and Statistical Process Control*. 2nd ed. Boca Raton, FL: CRC Press LLC.

Puls, R.W. and M.J. Barcelona. 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/S-95/504. U.S. Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response. Washington, DC.

USEPA. 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Updates I, II, IIA, IIB, III, and IIIA, EPA Publication SW-846*. Office of Solid Waste. Washington, DC.

USEPA. 1992a. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. Washington, DC.

USEPA. 1992b. *Management of Investigation-Derived Wastes*. Directive 9345.3-03FS. Office of Solid Waste and Emergency Response. Washington, DC.

USEPA. 1994. *Guidance for the Data Quality Objectives Process, EPA QA/G-4.* http://es.epa.gov/ncerqa/qa/qa_docs.html#G-4. EPA/600/R-96/055. Office of Research and Development. Washington, DC.

USEPA. 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. http://www.epa.gov/region04/sesd/eisopqam/eisopqam.html. Region 4, Science and Ecosystem Support Division. Athens, GA.

USEPA. 1998a. *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5*. http://es.epa.gov/ncerqa/qa/qa_docs.html#G-5. EPA/600/R-98/018. Office of Research and Development. Washington, DC.

USEPA. 1998b. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, *EPA QA/R-5.* External Review Draft Final. http://es.epa.gov/ncerqa/qa/qa_docs.html#R-5. Quality Assurance Division. Washington, DC.

USEPA. 1999. *Survey of Surface Impoundments* (OMB 2050-0157), Office of Solid Waste, Washington DC.

USEPA. 2000. Surface Impoundment Study Technical Plan for Human Health and Ecological Risk Assessment. Prepared by Research Triangle Institute and Tetra Tech, Inc. under Contract No. 68-W-98-085. February 2000.

ATTACHMENT A

DQOs DEVELOPMENT DOCUMENT

SURFACE IMPOUNDMENT STUDY
FIELD SAMPLING AND ANALYSIS PROGRAM

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DQO DEVELOPMENT DOCUMENT

SURFACE IMPOUNDMENT STUDY
FIELD SAMPLING AND ANALYSIS PROGRAM

DRAFT

Revised December 13, 1999

Submitted to:

U.S. Environmental Protection Agency
Office of Solid Waste
2800 Crystal Drive
Crystal City, VA 22202

Submitted by:

Science Applications International Corporation
11251 Roger Bacon Drive
Reston, Virginia 20190

EPA Contract No. 68-W6-0068, WA No. 2-19
SAIC Project No. 06-5140-08-9947-000

Table of Contents

DQO DEVELOPMENT DOCUMENT

SURFACE IMPOUNDMENT STUDY
FIELD SAMPLING AND ANALYSIS PROGRAM

1. Introduction

1.1 Background

The Land Disposal Program Flexibility Act (LDPFA) of 1996 (PL 104-119) amended Section 3004(g) of the Resource Conservation and Recovery Act (RCRA) by requiring a risk characterization study of hazardous waste managed in units regulated under the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) program, pretreatment program, or in a zero discharge system. These wastes are "decharacterized" waste, meaning they formerly exhibited a hazardous characteristic such as corrosivity, reactivity, ignitability, or toxicity.

In addition, under a consent decree in the matter of *Environmental Defense Fund v. Browner*, EPA is studying non-hazardous waste in surface impoundments, where those wastes never exhibited a hazardous waste characteristic. This portion of the study is limited to human health risks posed by air emissions via the "direct inhalation" pathway, and thus only volatile, semi-volatile, and fugitive emission constituents are of concern at the facilities whose surface impoundments fall into this category. 105 of the chemical constituents within the study's scope are explicitly required to be studied. The purpose of these studies is to obtain such information as the Administrator may require to determine whether a rulemaking to promulgate a hazardous waste characteristic that addresses potential risk to human health through the direct inhalation pathway should be initiated.

EPA's Office of Solid Waste (OSW) administered a screening survey to identify facilities having in-scope surface impoundments operating during the period of interest and to identify the type of wastewater being managed in any surface impoundments that are operating during the period of interest. Approximately 215 facilities were selected to receive a long survey detailing the characteristics of the surface impoundments they manage. The data collected from these 215 facilities will be screened and modeled to determine if they pose a hazard to human health and the environment.

In their review of OSW's Surface Impoundment Study (SIS) Plan (USEPA and SAB, 1998), the Science Advisory Board (SAB) advised OSW to apply the risk characterization scheme to a few impoundments early in the study with actual site monitoring data to provide "groundtruth." In addition, the SAB emphasized the need for obtaining extensive field monitoring data to perform model validation (i.e., "ground-truthing") by comparing calculated (modeled) values to measured values. In response to SAB's recommendation for groundtruthing and other project needs, OSW

has initiated the SIS Field Sampling and Analysis Program.

The first planning step of the Field Sampling and Analysis Program is the development of data quality objectives (DQOs). The objective of the DQO process is to develop a sampling and analysis strategy to that will satisfy certain data requirement for the SIS. Representatives from the OSW Surface Impoundment Study (SIS) Team have been involved in the planning for this project.

1.2 Overview of the Data Quality Objectives Process

The data generated as a result of the SIS Field Sampling and Analysis Program will be used to support the objectives of the Surface Impoundment Study. Data quality, therefore, must be acceptable to OSW for its intended use(s) to: verify facility submitted data, fill gaps in existing data, validate models outputs, and use as inputs in the risk analyses.

To be successful, the SIS Field Sampling and Analysis Program must yield data of the type and quality necessary to achieve the purpose of the program. This will be accomplished through correct, focused, and well-documented sampling, testing, and data evaluation activities. A clear understanding of the program objectives and thorough planning of the effort are essential for the sampling and analysis program to be successful and cost-effective.

The DQO Process (see Figure 1) will yield qualitative and quantitative statements that:

- Clarify the study objective
- Define the type, quantity, and quality of required data
- Determine the most appropriate conditions from which to collect the samples
- Specify how the data will be used.

DQOs will be used to define the quality control requirements for sampling, analysis, and data assessment. These requirements will then be incorporated into the quality assurance project plan (QAPP) and individual site-specific SAPs.

The approach for developing DQOs for

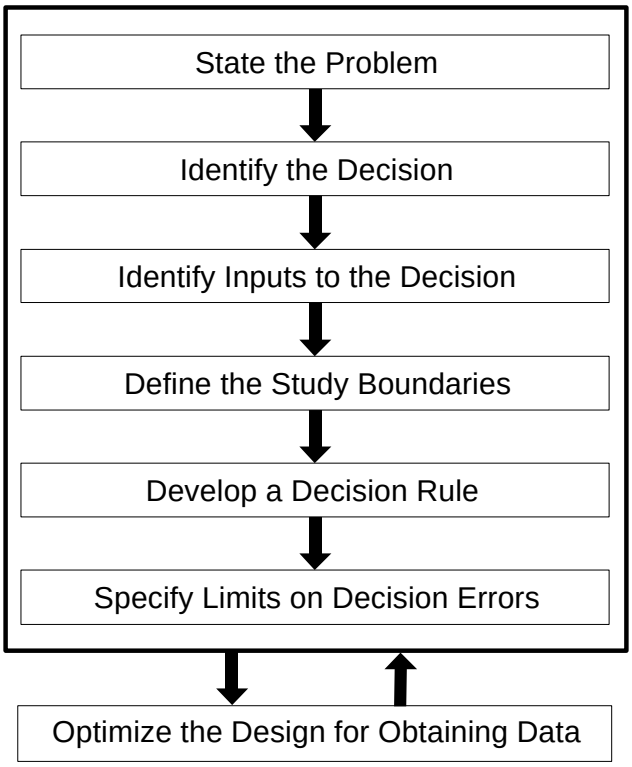

Figure 1. Seven Steps of the DQO Process

the SIS Field Sampling and Analysis Program is based on the guidance presented in EPA's *Guidance For The Data Quality Objectives Process, EPA QA/G-4* (September 1994). The process as applied in this report focuses on the first five steps.

2. Data Quality Objectives

2.1 Step 1: State the Problem

2.1.1 Purpose

To define the problem so that the focus of the study will be unambiguous.

2.1.2 Activities

- Identify members of the planning team.
- Identify the primary decision maker.
- Develop a concise description of the problem.
- Specify available resources and relevant deadlines for the study.

2.1.3 Outputs

2.1.3.1 Planning Team

Table 1. DQO Planning Team

Name/Organization	Role/Responsibility	Contact Information
Ollie Fordham, USEPA	EPA WAM	703-308-0493
Becky Cuthberson, USEPA	SIS Team Member	703-308-8447
Barnes Johnson, USEPA	EMRAD Div. Dir.	703-308-8881
Shannon Sturgeon, USEPA	SIS Team Member	703-605-0509
Jan Young, USEPA	SIS Team Member	703-308-1568
Charles Sellers, USEPA	EPA QA Officer	703-308-0504
Bob Stewart, SAIC	Contractor WAM	703-318-4654
Ray Anderson, SAIC	Contractor Laboratory Coordinator	703-645-6908
Pat Ransom, SAIC	Contractor Envi. Engineer	703-318-4681
Subcontractor Laboratory *[to be determined*]	Analytical Services	

Additional members of the technical and management team, not directly involved in the planning phase, include the following:

- Dr. Harry McCarty, SAIC, QA Officer
- Mary Wolfe, SAIC, QA Officer (supporting Dr. McCarty)
- Sara Hartwell, SAIC Program Manager

Other technical staff will be identified as the planning process progresses. A comprehensive organization chart showing the lines of communication between key staff will be included in the QAPP.

Stakeholders include industry/trade groups (e.g., CMA, API) and environmental groups (e.g., EDF).

2.1.3.2 Decision Makers

Decision-making regarding the field sampling and analysis program will be made by consensus of the EPA SIS Team. Direction to SAIC will be provided by Ollie Fordham (EPA WAM) only.

As recommended by the Science Advisory Board (USEPA and SAB, 1998), EPA will subject all quality assurance project plans and sampling and analysis plans to a multi-disciplinary (e.g., field, laboratory and QA personnel, toxicologists, risk assessors, statisticians, and data users) review to ensure that data collection will be appropriate for its intended use, as specified in the DQO process.

2.1.3.3 Concise Description of the Problem

EPA is conducting a study of facilities which manage industrial waste in surface impoundments. Part of the study is mandated by Congress under the 1996 Land Disposal Program Flexibility Act. Congress asked EPA to characterize risks posed by managing wastewaters in surface impoundments that are regulated under the CWA, and to determine whether existing regulations adequately address risks that may be present. The scope of the study covers industrial wastewaters, and does not include wastewaters classified as hazardous wastes under RCRA. EPA will characterize the population of nonhazardous waste surface impoundments in the United States and estimate the potential human health and ecological risks from chemical releases from nonhazardous surface impoundments.

The risk estimates derived by EPA will be one factor in EPA's determination of the need for regulations to address potential risks. In addition to the risk estimates, EPA will use the information to profile the attributes of nonhazardous waste surface impoundments and their physical settings (e.g., their hydrogeologic settings, geographic distribution, and surface impoundment use patterns across industries).

2.1.3.4 Summary of Available Resources

- Budgets

  EPA has committed sufficient resources for the contractor to develop DQOs, prepare a detailed QAPP, and assistance with selection of facilities to be sampled. Budgets for preparing SAPs, implementing field sampling and analysis, and preparing reports have not been developed by the contractor but will be prepared as requested under future amendments to the contract work assignment.

  EPA estimates that current funding will allow for sampling and analysis to be conducted at approximately 15 to 20 facilities. Due to funding and other practical constraints (e.g., mobilizing field teams to multiple sites), the field sampling must be limited in scope.

- Relevant time constraints/schedules

  Table 2 provides a timetable for the planing, implementation, and data assessment phases of the field sampling and analysis program. Ideally, selection of specific sites to be sampled will take place after EPA receives the survey responses and evaluates the need for sampling data from various industry sectors. In practice, some facilities may be granted an extension on submittal of the survey responses to allow sufficient time to complete their own sampling and analysis program. To meet the overall project schedule, EPA plans to schedule initial sampling events before all surveys are received and evaluated. After receipt of new survey data and after the initial sampling has been completed, EPA will make further decisions about the need for new sampling data and select additional sites for sampling.

Table 2. Time Constraints/Schedule

Task	Target Date
Planing Phase	
Develop Data Quality Objectives	Nov. - Dec. 1999
Deliver Draft QAPP to EPA	December 20, 1999
Deliver final QAPP to EPA	Mid January, 2000
Retain subcontractor lab(s)	February, 2000
Select facilities for sampling (after surveys return)	Early March, 2000
Prepare facility-specific sampling & analysis plans	March, 2000
Implementation Phase	
Obtain field supplies, contact facilities to be sampled, arrange staff and travel.	March, 2000
Mobilize equipment & field team(s) and begin field sampling	Late March, 2000
Complete field sampling	First week of June, 2000
Complete laboratory analyses of final batch of samples	First week of July, 2000
Assessment Phase	
Complete data verification/validation	August 1, 2000
Deliver Final Reports	September 1, 2000

2.2 Step 2: Identify the Decision

2.2.1 Purpose

To define what specific decisions need to be made or what questions need to be answered.

2.2.2 Activities

- Identify the principal study question.
- Define the alternative actions that could result from resolution of the principal study question.
- Develop a decision statement.
- Organize multiple decisions.

2.2.3 Outputs

2.2.3.1 Principal Study Questions and Alternative Actions

As mandated by Congress in the 1996 LDPFA, EPA must characterize risks posed by managing wastewater in surface impoundments and determine whether existing regulations adequately address risks that may be present. Multimedia models are needed to estimate human health and ecological risks. To complete the risk analyses, data are required on chemical input, output, and loss to the environment (via the subsurface and air). These data will include monitoring data, modeled data/extrapolations, data obtained from existing data bases, and assumptions. In their review of OSW's Surface Impoundment Study Plan (USEPA and SAB, 1998), the SAB advised OSW to apply the risk characterization scheme to a few impoundments early in the study with actual site monitoring data to provide "groundtruth." In addition, the SAB emphasized the need for obtaining extensive field monitoring data to perform model validation (i.e., "ground-truthing") by comparing calculated (modeled) values to measured values. (It is noted that the proposed use of monitoring data (representing current site conditions) to verify model outputs will not answer questions of long-term contaminant accumulation in sinks and environmental receptors.)

To address the need for actual monitoring data, OSW is requesting monitoring data from approximately 215 facilities via the *Survey of Surface Impoundments* (USEPA 1999). To supplement the facility-supplied data, fill possible data gaps, and to provide confidence that facility-supplied sample analysis results are reasonable, OSW will conduct field sampling and analysis of selected facilities.

Table 3 presents the use of monitoring data translated into study questions and alternative actions.

Table 3. Study Questions and Alternative Actions

Study Questions	Alternative Actions
Primary Study Question	
Do surface impoundments that are within the study's scope pose unacceptable risks to human health and the environment? [*Note: EPA may pose this question for each industry sector.*]	1. No further action 2. Additional regulation, controls, or study
Field Sampling and Analysis Study Questions	
Do field monitoring data verify (i.e., "ground truth") what the models predict?	1. Conclude that the model is valid. 2. Investigate discrepancy.
Are the sample analysis results provided by the facility reasonable and within the range of values expected?	1. Accept industry-supplied data. 2. Investigate discrepancy.
Are there gaps in the industry-supplied that limit the Agency's ability to perform fate and transport modeling and risk analyses using actual monitoring data?	1. Conduct field sampling and analysis to fill data gaps. 2. Do not conduct field sampling and analysis.

2.2.3.3 Decision Statements

The primary decision statement associated with the overall SIS is as follows:

> Determine whether releases from surface impoundments that are within the study's scope pose unacceptable human and ecological risks and require further action, or recommend that no further study or action is necessary.

For the field sampling and analysis component of the SIS, several additional decision statements include the following:

> Determine, using actual field monitoring data (both submitted by facilities and generated by EPA), whether or not the multimedia models provide accurate output.
>
> Determine, using EPA field monitoring data as a "spot-check" and using process knowledge, whether or not facility-supplied data are reasonable and within the range of values expected or whether the data should be questioned and the discrepancy investigated.
>
> Determine whether or not there are gaps in the industry supplied data and whether those gaps should be filled by conducting field sampling and analysis, or by other means (such as requesting additional information/clarification from the facility).

The decision statements are presented in Figure 2 as a decision flow diagram.

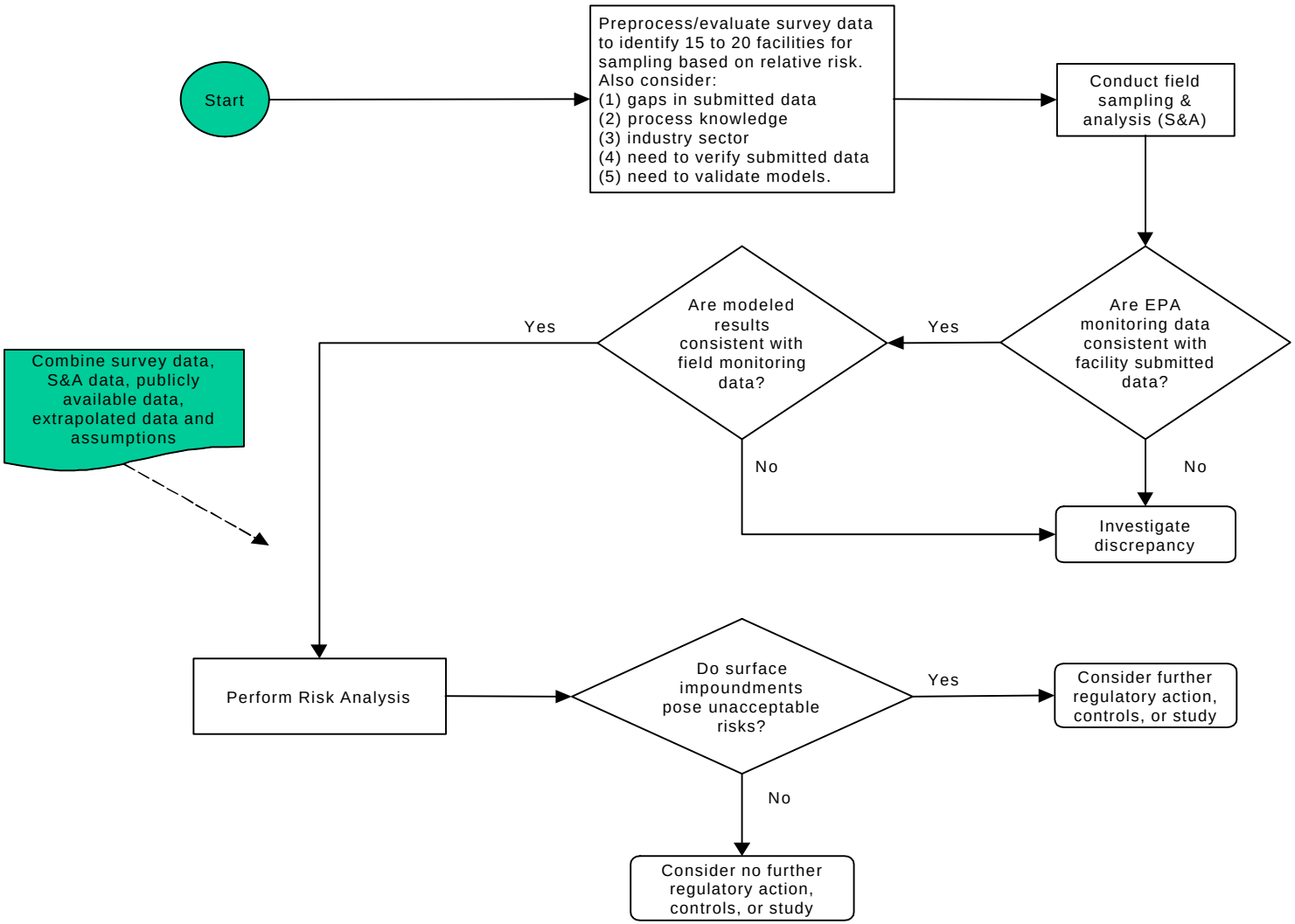

Figure 2. The DQO Decision Statement, presented as a simplified flow diagram, showing the relationship between field sampling and analysis and the overall study objectives.

2.3 Step 3: Identify Inputs to the Decision

2.3.1 Purpose

To identify data or other information required to resolve the decision statement.

2.3.2 Activities

- Identify the information required to resolve the decision statement.
- Determine the sources of information for each item identified.
- Identify information needed to establish the action level.
- Confirm that appropriate analytical methods exist to provide the necessary data.

2.3.3 Outputs

The information (inputs) required to resolve the decision statement are presented in Table 4.

Table 4. Inputs and Sources of Information or Data

Input	Use	Available Now (Y/N)	Source
Risk goals to be achieved	**S** To establish a basis for action	Y	EPA policy. The SIS Team has agreed that the risk goals are: *cancer risk no greater than 10^{-5} and hazard index no greater than 1*.
List of chemical constituents of interest (will be facility- or industry category-specific)	**S** Source characterization	Y	Comprehensive list provided in Appendix 2 of *Survey of Surface Impoundments*. A preliminary facility-specific list has been developed by the EPA SIS Team (*see "workfile.wk4"*).
List of water quality characteristics	**S** Source characterization	Y	Planning team requested temperature, pH, and conductivity. See Table C15 in Survey of Surface Impoundments for a more extensive listing.

Table 4. Inputs and Sources of Information or Data

Input	Use	Available Now (Y/N)	Source
Chemical constituent concentration (mg/L) for influent, water within impoundment, sludge (>5% solids) within impoundment, effluent, and leachate from leachate collection system.	**S** Source characterization **S** Exposure point characterization **S** Verify model outputs	N	Survey responses and EPA field sampling and analysis
Influent and effluent flow rates	**S** Estimate mass flux	N	Survey responses or measurement in the field. *Need to identify measurement method in DQO Step 7.*
Leaching data from solid media. Use leaching test (e.g., TCLP or SPLP on sludges from closed facilities only) or obtain cores and extract the liquid phase.	**S** Estimate concentration of chemicals in leachate generated from solid media	N	EPA field sampling and analysis
Wastewater treatment and environmental setting information and data	**S** Verify survey data **S** Fill data gaps for input into models and risk assessment	N	Field observations during EPA field sampling and analysis
Estimates of minimum concentration levels or benchmarks, by media, that might trigger exceedance of risk goals	**S** Establish minimum detection limits required	To be determined.	Need to review Pilot Study risk assessments and benchmarks used in hazardous waste listing determinations.
Analytical Methods	Sample analysis	N (Specific methods to be determined. See related discussion at the end of this section)	**S** SW-846 **S** Part 136 Methods **S** [*others to be discussed. The lab should be involved as early as possible.*]
Detection Limits	Sample analysis	N (Required detection limits to be determined. See related discussion at the end of this section.)	Matrix-specific detection limits will need to be determined by the laboratory.

Table 4. Inputs and Sources of Information or Data

Input	Use	Available Now (Y/N)	Source
Special training requirement or certifications	Worker health and safety. Compliance with OSHA regulations	Y	OSHA 29 CFR 1910.120
Sample handling and custody procedures	Sample and data integrity	Y	SW-846, EPA regional guidance documents, ASTM, and contractor SOPs.
Sampling and Subsampling Methods	Sample collection	N	SW-846 and ASTM
Size, shape, and orientation of field samples	Control sampling precision	Y (for waters) N (for solid matrices)	Matrix specific. Water samples are to represent a depth of 0 to 3 feet. Gy's sampling theory will be used to estimate appropriate sample mass for solids.

One of the key inputs to the QAPP and sampling and analysis plan is the specification of analytical methods and required detection limits. For the SIS, the sample analysis results may be used with other data as input into risk analyses, and the detection limits must be sufficiently low to support the analyses.

At the time of publication of this draft DQO document, the EPA SIS Team and SAIC staff are still working to identify appropriate methods and detection limits. In general, the project team plans to review each potential chemical constituent of concern (as listed in Appendix 2 of the *Survey of Surface Impoundments*) and published human health benchmarks (e.g., RfDs for ingestion of soil and water, and CSFs for ingestion of soil and water). In addition, it might be useful to list relevant "reality check" numbers such as MCLs, soil background levels, sewage sludge levels, etc. to serve as a basis for specifying target detection limits. Most of the required benchmarks and "reality check" concentration levels are available in documents recently published in support of the proposed Hazardous Waste Identification Rule.

2.4 Step 4: Define the Study Boundaries

2.4.1 Purpose

To define the spatial and temporal boundaries that are covered by the decision statement.

2.4.2 Activities

- Specify the characteristics that define the population of interest.
- Define the spatial boundary of the decision statement.
- Define the temporal boundary of the problem.
- Define the scale of decision making.
- Identify any practical constraints on data collection.

2.4.3 Outputs

2.4.3.1 Characteristics That Define the Population of Interest

The population of interest is all wastewater managed in surface impoundments that satisfy the definition of surface impoundment specified in the *Survey of Surface Impoundments* (OMB 2050-0157), including sludges removed from the surface impoundments.

As part of DQO Step 7, it will be necessary to define industry sectors or "strata" from which individual facilities will be selected for sampling. This decision will be made after review of survey results, review of the *Technical Plan* [in progress], and in consultation with the EPA SIS Team.

2.4.3.2 Spatial Boundary

- The spatial boundary for the entire study is the United States.

- The spatial boundary for characterization of individual surface impoundments will be defined, at a minimum, by its dikes or topographic depression including influent and effluent points, leachate in the leachate collection system, and sludge in the impoundment or actively being removed from the impoundment.

Note: Due to budgetary and practical constraints, the boundary of the fields sampling and analysis program **will not include affected media** such as ground water, soil, surface water, biota, vegetation, air.

2.4.3.3 Temporal Boundary

Sampling must be completed by early June, 2000 so that data can be supplied to data users by August or September, 2000.

The sample data will only apply to the time at which the samples were taken (i.e., represent current conditions). Modeling will be used to predict future movement of constituents. Samples can be used verify some modeling results.

A decision must be made by the EPA SIS Team regarding the use of grab samples to obtain a "snap shot" of site conditions at the time of sampling versus the use of composite samples (e.g., using Isco-style autosamplers) to obtain samples that represent a longer time frame (such as a 24-hour period).

2.4.3.4 Scale of Decision Making

Ultimately, the scale of the decision will be national (i.e., the entire U.S.), however, individual risk modeling will be conducted on a unit-specific scale and possibly aggregated into industrial categories or into categories based on similarities of waste management practices (see Table 5).

At the facility scale, the size (dimensions) of each surface impoundment should be documented, either from a survey response or from direct observation by the field team.

Table 5. Scale of the Decision Making

Geographic Scale	Strata (Industrial Category or Waste Management Practice Category*)	Facilities Selected For Field Sampling**
Entire United States		TBD***
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD
		TBD

* Stratification may be based on similarities of waste management or treatment practices (e.g., biological vs. no biological treatment) or based on industrial classification, such as by SIC code or NAICS codes.
** Facilities will be selected for sampling based on relative risk., heterogeneity within an industry sector, o the need to fill data gaps.
*** To be determined after analysis of the survey results (approximately February 2000).

2.4.3.5 Practical Constraints On Data Collection

Practical constraints might include:

- limited physical access to a sampling location
- unfavorable weather conditions
- unexpected waste characteristics (may require use of specialized shipping containers or unique sampling device)
- health and safety issues (to be addressed in the H&S plan attached to the QAPP)
- unavailability of waste (e.g., there is no influent at the time of sampling).
- lack of cooperation from facility owner/operator.

2.5 Step 5: Develop a Decision Rule

2.5.1 Purpose

To define the parameter of interest, specify the action level and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions; i.e., define how the data will be used to make a decision.

2.5.2 Activities

- Specify the parameter of interest.
- Specify the action level for the study.
- Develop a decision rule.

2.5.3 Outputs

The sample analysis data generated from the field sampling program will be used in combination with other data (e.g., publicly available data, extrapolated data, assumptions, survey data, etc.) to determine, with an acceptable degree of certainty, what risks to human health and the environment are posed by constituents present in industrial wastewaters managed in nonhazardous waste surface impoundments. The sample analysis results alone will not be used to estimate a "statistical parameter of interest" (such as the mean or a percentile), rather, the data obtained from field sampling will be used to *supplement* survey data as it is impractical for EPA to use field samples as a primary source of data.

There are no concentration-based action levels defined for decision-making, rather, the risk assessment process will generate estimates of risk. The EPA SIS Team has specified risk goals for the study as: cancer risk no greater than 10^{-5} and hazard index no greater than 1.

To the extent possible, the monitoring data will be evaluated to respond to two of the study questions as discussed below:

Verification of facility-submitted data: Our ability to use the EPA generated data to verify facility-supplied data will be highly dependent upon the form, quantity, and quality of the facility-submitted data. For example, if a facility only submits a single average value for a constituent in an impoundment effluent, then it will not be possible to make a meaningful comparison of that value to the EPA sample analysis results obtained from the sample effluent. If however, a facility submits individual observations (or a statistical summary of such observations), then it may be possible to construct a statistical interval or some other test to compare the data sets.

As an alternative to statistical analysis of the data, an assessment of the data could be made by using expert opinion to ensure that the values being checked are not wildly improbable, or that they are within the range or limit that is considered reasonable.

Validation of model outputs: One objective is to use actual site monitoring data to determine whether the multimedia models provide accurate output (i.e., to compare actual field data to calculated (modeled) risks). It is anticipated that both facility-supplied data as well as the EPA generated data could be used for this purpose, however, the exact procedure for validating the model outputs has not been specified as part of the DQO process. Additional information will be available after publication of the *Technical Plan* [in progress] and after EPA has specified which models need validation.

2.6 Step 6: Specify Limits on Decision Errors

2.6.1 Purpose

To specify the decision maker's tolerable limits on decision error.

2.6.2 Activities

- Determine the possible range on the parameter of interest.
- Identify the decision errors and choose the null hypothesis.
- Specify an acceptable margin of error.
- Specify an acceptable probability of making a decision error.

2.6.3 Outputs

Because the data generated from the study will not be used directly to test a hypothesis, this step of the DQO Process does not apply to the SIS field sampling and analysis program.

2.7 Step 7: Optimize the Design for Collecting the Data

2.7.1 Purpose

To identify a resource-effective data collection design for generating data that are expected to satisfy the DQOs.

2.7.2 Activities

- Consider various data collection design options, including sampling and analytical design alternatives, and composite sampling options.
- For each data collection design alternative, determine the appropriate number of samples that will satisfy the DQOs.
- Select the most resource-effective design that satisfies all of the DQOs.
- Prepare the QAPP and facility-specific SAPs.

2.7.3 Outputs

An optimal sampling design is one that obtains the requisite information from the samples for lowest cost and still satisfied the DQOs.

2.7.3.1 Data Collection Design Options

- **Analytical Design** - The analytical design will be optimized by analyzing only for those constituents of concern likely to be present in the waste or only for those constituents for which data are missing and required by EPA. The EPA SIS Team has developed an initial list of constituents of concern for each of the 215 facilities in the survey. This list will serve as a starting point for developing the analytical design in the QAPP and facility specific sampling and analysis plans.

- **Sampling Design** - Options include simple random, stratified random, systematic, or authoritative/judgmental sampling. By design, the population of interest will be stratified (see Table 5 in Section 2.4.3.4). Due to practical constraints, field sampling will be judgmental. The sampling design can be further optimized by locating facilities in geographic clusters to minimize travel time and costs.

2.7.3.2 Number of Samples

To be determined. A table will be completed for each facility (in the facility-specific SAP) to specify the number and type of field samples to be obtained and required analytical methods. The information also can be used to determine the number and type of field and laboratory QA/QC samples required. The SIS Team can then iterate back through the DQO Process to review the budget, schedule, etc. and modify the number of samples up or down as needed (see Table 6).

Table 6. Example Format For Specifying the Location, Type, and Number of Samples and Analyses (*to be completed for each facility selected for sampling*)

Facility Name	Media/Matrix Type	Analysis Method							Total Samples
		Metals	Ext Org/Pest/PCBs	Volatiles	Cyanide	Water Qual Param.			
TBD	Influent								
	Wastewater								
	Sludge								
	Effluent								
	Leachate								
Totals									

2.7.3.3 Selection of Most Resource-Effective Design

Given a fixed budget and the limited time frame within which to complete the study, the most resource effective design will be one that (1) fills gaps in data required to validate models, (2) fills gaps in data required to complete the risk analyses, and (3) verifies facility-supplied data.

2.7.3.4 Preparation of QAPP and Facility-Specific SAPs

The first draft of the QAPP will be completed by December 20, 1999. The QAPP will be developed following the requirements specified in *EPA Requirements For Quality Assurance Project Plan For Environmental Data Operations, EPA QA/R-5* (USEPA 1998b).

References

USEPA. 1994. *Guidance For The Data Quality Objectives Process, EPA QA/G-4*. EPA/600/R-96/055. Office of Research and Development, Washington, DC.

USEPA. 1998a. *Background and Response to Comments Document: Land Disposal Restrictions Surface Impoundment Study*. 2/9/98.

USEPA. 1998b. *EPA Requirements For Quality Assurance Project Plan For Environmental Data Operations, EPA QA/R-5*. United States Environmental Protection Agency Quality Assurance Division, Washington, DC 20460 (External Review Draft, Final), October 1998.

USEPA and Science Advisory Board. 1998. *An SAB Report: Review of the Surface Impoundment Study (SIS) Plan – Review of the Office of Solid Waste's Proposed Surface Impoundment Study by the Environmental Engineering Committee*. EPA-SAB-EEC-98-009. August.

USEPA. 1999. *Survey of Surface Impoundments*. OMB 2050-0157. Office of Solid Waste, Washington, DC.